January 10, 1929

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Engineering News-Record

Devoted to Civil Engineering and Contracting

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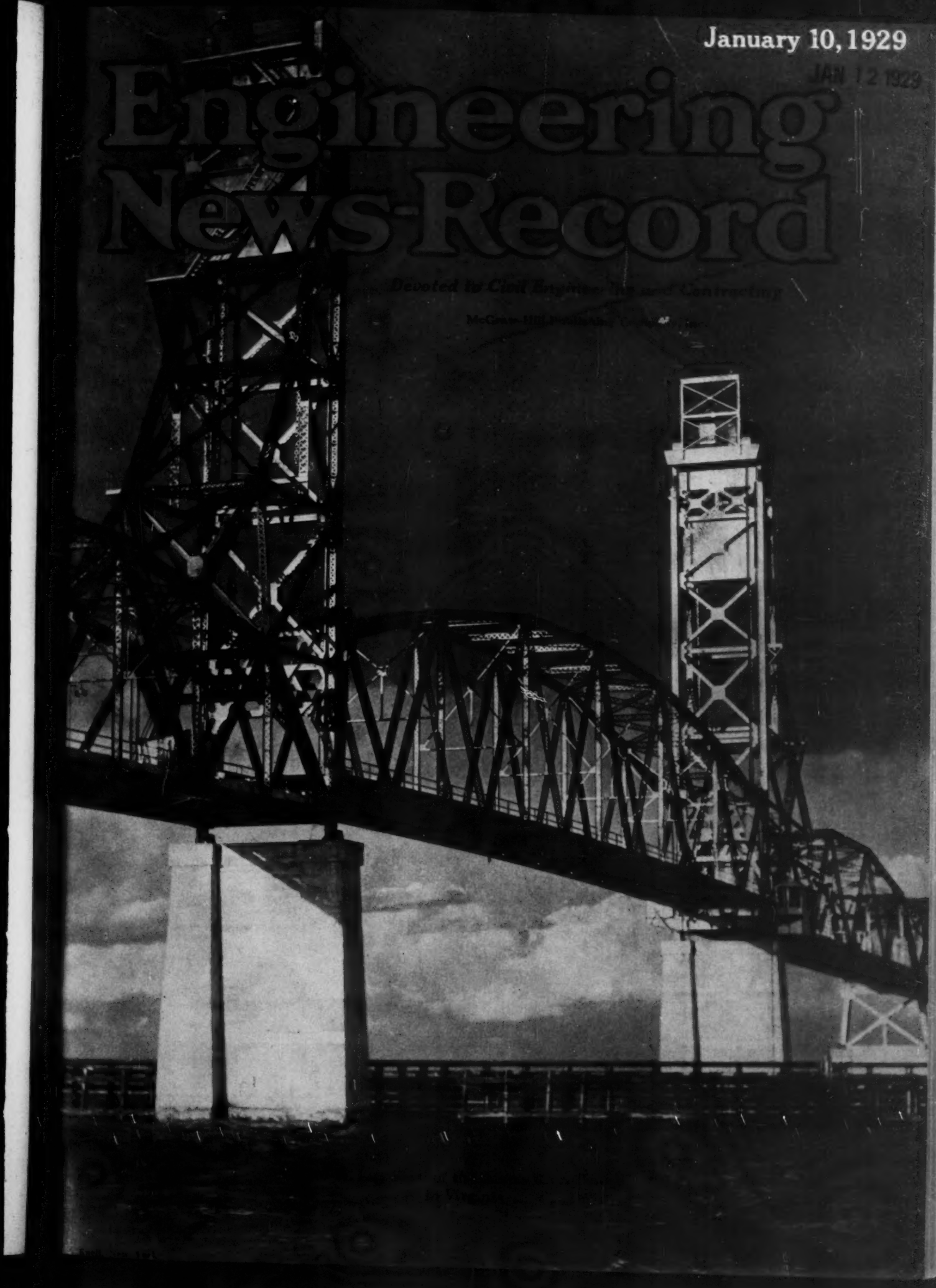

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Forty Million Dollars

BUILDING flood-control work along the Mississippi this season will amount to more than $40,000,000. Much of the work will be done by contract. Its efficiency depends on how fully contractors and machine builders are prepared.

A TOUR of investigation of the current construction problems has just been completed by one of the most experienced members of the editorial staff of *Engineering News-Record*, Charles S. Hill. His report shows that new kinds of work are to be done and that successful attack on the contractor's problems of levee building will involve many points of serious study.

Mr. Hill's findings will appear in two articles beginning next week.

* * *

Concrete

A REMARKABLY stimulative group of articles by the well-known student of concrete Nathan C. Johnson will begin in the Jan. 24 issue.

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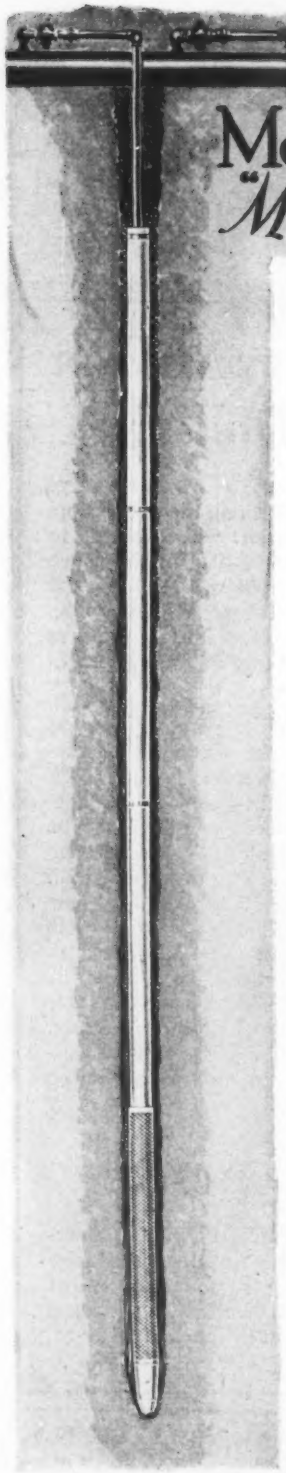

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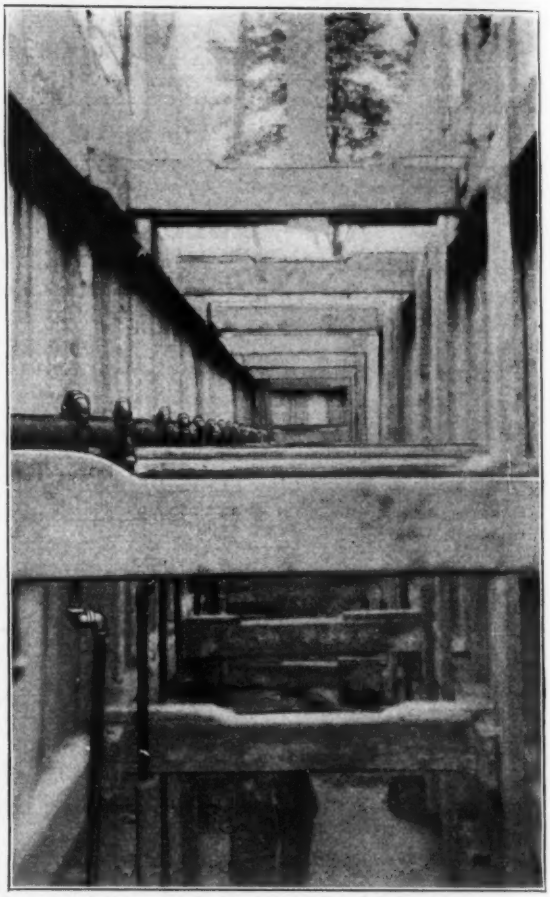

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Within Twenty Years

ALMOST beyond belief, yet true: after seventeen years of effort to amend the standard specifications for cast-iron pipe most commonly used in this country the work is still in the committee stage. If it so continues much longer it will have covered twoscore years. That is a long period for committee work on any subject before fruition. Since the Engineering Standards Committee, to which the task of revision has been consigned by the water-works and other associations concerned, now gives promise of achieving more rapid progress, it seems unnecessary to review the history of delays, as there is a temptation to do. It is in order, however, to express a hope that the present large joint committee will speed up its work as much as is reasonably possible, so that at least within two decades of the original move for revision and consolidation of the specifications of the New England and American Water Works associations that purpose, broadened by the co-operation of other bodies, will have been accomplished.

Construction Speed

AGAIN we record in this issue the completion of a major construction project far in advance of the contract limit. The James River bridge project, completed in thirteen months in place of the two-year construction period forecast, is another example of the fact that fast construction schedules are becoming the rule rather than the exception in modern practice. Preliminary study, thorough organization of forces and co-ordination of progressive steps made this feat possible at James River. The project permitted many repetitive construction methods. Careful study of details of the methods to be repeated was rewarded in money and time saved. The early completion resulted in savings in overhead and equipment charges to the contractor, but far greater in magnitude was the return in saving of interest on construction cost and the earlier revenue realized by the owners. Such savings are a distinct economic asset to any project, private or public. The financing of modern projects demands early completion to reduce interest charges on capital invested and to permit a quicker return on investments, as is indicated by shorter and shorter contract time limits. It is to the credit of present-day contracting organizations that they are meeting these demands even beyond the expectations of the promoters and owners.

One Factor of Change

TODAY our ways of living are being modified so rapidly and by so many separate influences that each one of them challenges consideration by him who would comprehend the events of today and be prepared for tomorrow's changes. In the last analysis all of these modifications not only affect human habit but slowly transform industry and determine its future course. There is constant development of new materials, new forms and new uses, for example; but there is also a wide importance in more superficial changes. One of these is a progressive increase in the practice of packaging commodities. Daily some item of bulk or "loose" goods is being changed over into a packed article, and it may be taken for granted that each such change is in the interest of all-around economy and efficiency. Even lumber is being sold in packages! Only in the rarest instances, as in cement, does progress at times seem to be toward bulk distribution and away from the packing system; the exceptions merely emphasize the strength of the general trend. So many channels and tools of industry are involved in the resulting transformation that the engineer is quite directly concerned. He may look forward to continuous growth of container-producing industries, sheet metal and paper as well as wood; changes in handling systems in shop and transport, and changes in warehousing and distribution facilities. Industry and commerce are bound to modify their methods of procedure in proportion to the changes in physical equipment. The consumer's taste and mental attitude also do not remain unaffected, and at times the influence of the consumer expresses itself strongly enough to produce a sudden acceleration of the movement. All these effects are matters which the engineer, whose existence is closely bound up with the development of industry's physical equipment, needs to observe and understand if he would be best prepared for tomorrow's duties.

Vermont Flood Control

CONSTRUCTION of a number of storage reservoirs on the headwaters of the rivers involved in the disastrous Vermont floods of 1927 has been recommended to the Governor of that state by an advisory committee of engineers. A little more than a year ago the state was swept by floods which caused great damage and much loss of life, particularly in the northern part. Only along the Deerfield River, with its large storage reservoirs for power development, was there no damage done. Taking a tip from the Deerfield example, the committee of engineers whose report is abstracted on page 72 of this issue has recommended similar reservoirs for the other rivers. Practical considerations have not been overlooked by the committee. Realizing that the state is in no position financially to stand the cost of flood-control reservoirs such as those in the Miami Valley in Ohio, it has picked out sites which can be developed economically for power purposes. The cost of the reservoirs it proposes to distribute among the power companies and communities benefited, as is done by the river-regulating districts of New York State. Such reservoirs will not be ideal for flood control, but there is every reason to believe that they will greatly reduce a maximum flood, if they do not entirely check it. For Vermont, it is a case of a half-loaf being better than none. With the proposed

reservoirs and with channels cleared of obstructions which had such a disastrous effect in the 1927 flood, the state should feel reasonably free from damage from the rare storms such as occurred a year ago. It seems probable that construction of the reservoirs will be undertaken by some state agency or under state control, but unless the removal of channel obstructions is put under similiar state control little will be done on that important element of the flood-relief plan.

Hydraulic Research

THIS country has been notably backward in the establishment of large hydraulic laboratories. In the present issue two hydraulic engineers discuss the need for a national hydraulic laboratory in the light of what has been done in Europe. Except for a few industrial and college laboratories, we have little opportunity for research in the design of hydraulic structures and nothing to compare with the river and harbor laboratories of Europe. A move to establish a national laboratory has been on foot for some time, but until the present it has not met with success, chiefly because it did not have the enthusiastic support of the army engineers, under whose direction most of our river work is carried out. Their want of interest was due in large part to the fact that government appropriations for such work have made no provision for research. They now appear to have the necessary authority to undertake special studies on the Mississippi. That is not enough. Provision should be made for more thorough research on many other subjects. It is inconceivable that this country will continue to lag behind Europe in such research with the many demonstrations of the practical value of such studies for private enterprise.

Noise Nuisances

ONE of the points in which our modern life surpasses that of earlier ages is the wealth of noise lavished on our sensibilities ceaselessly. We live and work in a persistent din, which is growing ever stronger, and almost we are becoming used to it—almost, but not quite. Within recent years the thought has grown up that we have altogether too much noise for comfort, and that something ought to be done about it. So far nothing has been done, because the dollars-and-cents meaning of noise nuisances has not yet come to the fore; but the sentiment will grow and in time will precipitate a fight against noise. Obviously, there are two points of attack —the production of noise and its unhindered transmission. The latter is of the more importance because some of our building practices are involved. Thinner or more resonant construction of floors and partitions, and elastic construction that transmits the tremor and roar of traffic, have come to be a real factor in making the noise nuisance ubiquitous. A beginning has been made in studies aiming to deal with this trouble. The sound-damping effect of different constructions has been compared at Harvard University, the Bureau of Standards, the University of Illinois and elsewhere. While the earliest efforts were directed at the special and limited problem of reverberation in auditoriums, later work has taken up the more generally practical problem of partition construction. Necessarily the investigation is difficult and diversified, and depends on delicate laboratory methods. Now, as set forth in the present issue, scientific method advances another step by the application of precise measurement of loudness. The perfection of such aids to exact study is sure to speed up progress significantly. We may look forward with more hope to a time when noise insulation will be incorporated regularly in engineering and architectural practice. Perhaps simultaneously the matter of noise generation will also be taken in hand to some effect.

Machine Stresses

A CLEAR analysis of the Hackensack River bascule bridge failure is set forth in the findings of the investigating board which reported last week. The collapse was due to weakness of the slender post or tower which formed the front member of the counterweight parallelogram and had the duty of holding the 770-ton counterweight vertically over the tailpin of the moving leaf. This member apparently had only light service to perform; it was subject to small static stresses. But its actual service as a member of a moving machine was more severe. This was demonstrated by stress measurements on the corresponding member of the west leaf, as well as by the evidence of progressive fracture of the failed member.

The accident was a machine failure, resulting from stresses, distortions and oscillations arising under operation against the forces of friction and inertia. As such, it is one of the most important structural accidents of recent times, perhaps the most instructive since the Quebec bridge collapse 21 years ago. Like the latter, it brings into the foreground certain neglected sources of stress which under proper circumstances take or controlling importance.

Because the heavy concrete counterweight with its supporting posts is still in the water, the weighty question of the condition of these posts remains unsettled. In the surviving west leaf these posts showed such a state of buckling of the lacing bars and tie plates that the investigating board considered them in imminent danger of failure and was not willing to approve of placing the leaf in service until they had been reinforced. We are here back to the old question of column web stresses, but with the added factor of stresses due to machine action—bending due to frictional effects, and possible torsion from unsymmetrical movements or forces. Clearly, members in such service may not be considered and proportioned in the same way as columns or struts in fixed structures.

With respect to the tower itself, it is startling to learn that its top showed a 6-in. range of motion, forward and back, when the span was moved slowly by the gasoline stand-by drive. With a structure so deficient in stiffness the faster operation under the normal electric drive and the possible sway effect of the great mass of concrete which it had to hold in line might readily develop to even more alarming proportions.

It is to be borne in mind, further, that the main pinion shaft of the span machinery was fitted with an equalizer, giving what amounts to independent drive of the two trusses, so that any inequality of resistances was opposed only by the torsional rigidity of the pony-truss moving leaf. Under such conditions, and with the large measured motions of the counterweight posts in longitudinal direction—in which direction they were much the stiffer —the occurrence of lateral deflections and oscillations would also come into question. And, in addition, a machine of this type is likely to develop large variations in friction when members connected to loaded journal bearings undergo distortion.

Thus the predominating machine effect of a moving structure of this type comes to light prominently in the Hackensack River bascule accident. It is important that the lesson be not overlooked in future construction, and perhaps equally important that existing structures exposed to machine stresses of the kind be examined to make sure that they are not likely to get into unsafe condition and thereby work unexpected havoc.

Power Prospects in New York

A SOLUTION of the problem which has held up water-power development in New York State appears nearer with the recent change in state administration than it has for several years past. "Time will not solve the problem; it must be solved now," is the statement concerning it made to the legislature by the new Governor. And except for the single pronouncement that "title to this power must vest forever in the people of this state," Governor Roosevelt comes before the legislature with no fixed views as to how or by whom the power shall be developed, transmitted or sold. He wants the power developed and is willing to compromise on all but the one fundamental principle in order to reach that end. In this his chances of success are much greater than were those of Governor Smith with his definite proposal for setting up a "power authority" to develop all the power resources still controlled by the state.

Before much of the state's power resource can be developed, however, there are difficulties which cannot be overcome simply through the Governor and the legislature reaching an understanding as to methods. The complications of federal and international jurisdiction along the St. Lawrence, for instance, are matters which are outside of state control and which will hold up development of large blocks of power for a few more years at the very least. But within the state itself there are difficulties to be overcome which are less tangible but quite as real. They are bound up in existing inhibitions against using any considerable part of the Adirondack forest preserve for water-storage purposes.

All the streams which have their source in the Adirondack Mountains are flashy streams. Outside of the St. Lawrence River, they are the principal sources of water power within the state, and consequently to make their power of most value they must have a large amount of storage to draw upon. Most of this storage must be obtained in the Adirondack Mountains in large reservoirs which will encroach upon the forest preserve at some point. Only occasionally, however, will this encroachment injure valuable forests, as much of the land to be taken is low-lying swamp land. But in a few instances, where the levels of existing lakes are proposed to be raised, summer camp sites will be flooded out and sections of large private estates will be taken. The people so affected resent the proposed encroachments and each time such proposals have been made they have succeeded in arousing enough public sentiment to defeat the proposal by the cry that the power trust is stealing the heritage of the people.

Governor Roosevelt may find it expedient to follow in the footsteps of his predecessor in the matter of educating the public on matters of state interest in order to offset the activities of these selfish individuals. With the Governor and the legislature in a mood to co-operate and the public intelligently informed on the need for storage reservoirs and the harmlessness of taking part of the Adirondack forest preserve for that purpose, much of New York's idle water power may soon be put to work. Without reservoirs to draw upon, few of the state's undeveloped power sites are worth developing at the present time.

A Question of Character

ONCE more, and may it be for the last time, the notorious Passaic Valley sewer outfall cases obtrude themselves upon notice. A whole series of contractors who had been despoiled or ruined on that enterprise has, one by one, recovered heavy damages in successful suits against the district for which the sewer was built. Some two millions of dollars has been assessed against the citizens of the district to right serious wrongs committed, we regret to say, by an engineer.

The details of the Haskin case, the last of the series, printed elsewhere in this issue, do not add greatly to the facts brought out previously (see the decision on Holbrook, Cabot & Rollins, reviewed in our issue of July 3, 1924, p. 21). But they emphasize strongly, because they involved an independent set of facts and were decided by independent judgment, the iniquity of the engineer's procedure. They show also that this iniquity was practiced consistently over a long period of time.

In essence, the engineer deceived the contractor as to the conditions he would find. He deceived him in such a way as to obtain lower prices for the district and cause loss to the contractor. Uniformly the court findings indicate that the deceit was conscious and deliberate. Inconceivable as it seems, yet such is found to have been the case.

As a possible explanation of such conduct it may be in order to recall that in past times, when contracting had a less substantial ethical background than today, engineer and contractor often occupied antagonistic positions. It was a situation that grew up rather naturally from the difference in their functions; but in the present connection it is important to remember that contractors have contributed to building up a wrong attitude on the part of some engineers. Many a contractor has made it a sport and an adventure (and an adventure of profit) to hoodwink owner and engineer, to beat the specifications and plans—in short, to do as little work and as poor work as he could scrape by with; and by thus placing himself in deliberate antagonism to the engineer, he inevitably invited and fostered a corresponding antagonistic attitude toward himself and his craft. It is to the credit of the contracting industry that it has striven to get away from this condition, and that the leaders of the industry are keenly aware of the dangerous influence of this speculative and debasing element in contracting. May the progress against it continue. Otherwise we shall again fall on evil ways in the relations between engineer and contractor.

But the basic element involved in the situation exemplified by the Passaic Valley sewer cases is the engineer's character. His character, no less than his technical knowledge, is back of the soundness of his designing, the success of his call for bids and award of contracts, and the efficiency of the construction of the work. In each of these operations, three components must be brought together: the physical conditions of the site and of the proposed work, the resources of the engineering art, and the possibilities of construction procedure. To bring these together in a fruitful result requires undeviating principle, rooted firmly in character. Without this, the engineer's work cannot succeed.

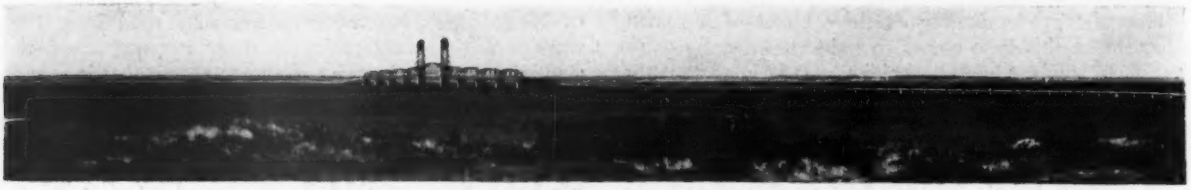


Fig. 1—Long Highway Bridge Across James River, Newport News, Va.

5-Mile James River Bridge Built in 13 Months

Tri-Bridge and Highway Toll Project Connects Newport News and South—Precast Piles 115 Ft. Long Used in Concrete Trestles—Simple Design Permits Rapid Repetitive Construction Methods

SPANNING the historic James River and two tributaries, three long highway bridges just completed, consisting of a single toll bridge and highway enterprise, form an important link in the Atlantic coastal highway system by traversing the tidewater area between Newport News and Portsmouth, Va. The new bridges open up a through route from Richmond to Norfolk and the South, formerly broken up by long detours inland or extensive ferry trips. Except for the draw spans and a few steel spans over deep water, the three bridges consist of 583 identical 44-ft. spans of simple I-beam and concrete-deck design resting on some 2,900 precast concrete piles. Some of the piles are 115 ft. long, a record for this type. Such a design offered an unusual opportunity for well-planned repetitive construction methods. That full advantage was taken of this opportunity is indicated by the fact that the entire project, consisting of 5.58 miles of bridges and 10.9 miles of new concrete highway, was completed within thirteen months' time.

A well-equipped base and pile-casting yard, an adequate fleet and repetitive construction methods that become almost mechanical, all controlled by an efficient organization working close to a detailed schedule, enabled the work to be finished in a little more than half the time allowed by the contract.

Description of the Project—As seen from the map in Fig. 2, the project consists of the James River bridge, 23,178 ft. long, the Chuckatuck Creek bridge, 2,529 ft. long, and a third bridge over Nansemond River, 3,761 ft. long, all three connected by 10.9 miles of new concrete highway. Short spans of 44-ft. length, made up of a 9-in. concrete deck slab, 23½ ft. wide, resting on four 30-in. I-beam stringers on bents of precast piles, make up the greater portion of the three bridges. The James River structure (Fig. 3) contains 447 of these short spans, supplemented by seventeen 90-ft. through plate-girder spans, and one 300-ft. vertical-lift truss span. The long spans are all grouped over the deep-water channel about ¾ mile from the north shore, except for a group of nine girder spans rising to an underclearance height of 28 ft. located about midstream as a small boat passage. In the Chuckatuck Creek bridge, 54 of the I-beam spans and one 154-ft. double-leaf rolling bascule span are used (Fig. 5). A similar bascule span is used at the Nansemond bridge, with 82 of the typical short spans.

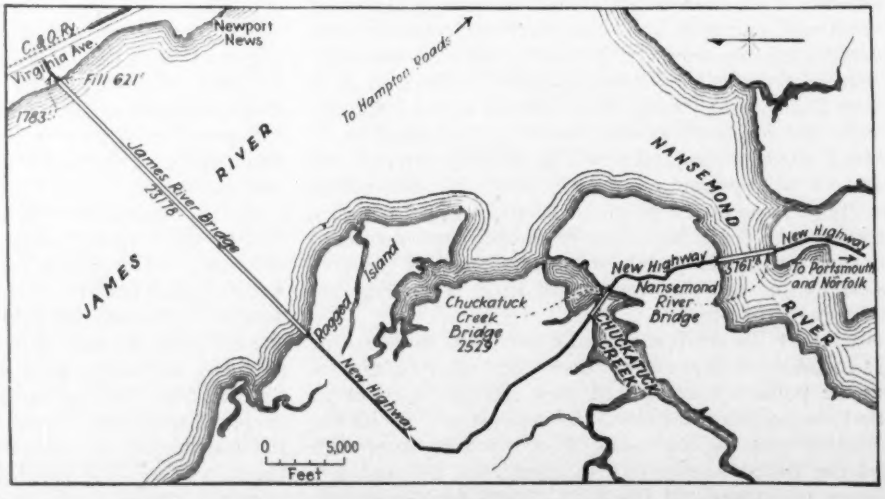


FIG. 2—MAP OF JAMES RIVER BRIDGE AND HIGHWAY PROJECT

Design of Bridge Units

I-Beam Spans—Simplicity marks the design of the I-beam spans, as can be noted from Fig. 6. The concrete bents are made up of four 18-in. or 24-in. square precast piles, 35 to 115 ft. long. Double bents are introduced every fifteen spans to provide longitudinal stability. Stiffening collars are used on the double bents. The 18-in. piles are capped with a 3x3½-ft. cap, 25 ft. long, while similar caps 3½x4 ft. in section are used over the 24-in. piles. Wide single caps are used on the double bents. Where a pile length of 115 ft. was insufficient, or in cases of long unsupported lengths of piling, the piles were capped and pony bents with web bracing built on the caps. Fig. 7 shows the typical bents used. The bridge seat caps of all bents are cambered to provide the roadway crown, as the deck slab is of uniform thickness. All piles are capable of supporting a load of 87,500 lb., exclusive of the weight of the pile, the unsupported length and conditions of the river bottom determining the use of the 18-in. or 24-in. size. Concrete testing 3,500 lb. per sq.in. in 28 days was specified for the piling, though tests showed that most of the concrete used averaged 4,500 lb. and some as high as 6,000 lb.

The I-beam stringers are 30 in., 115 lb., 43 ft. 9 in. long, each fastened to the caps by four 1¼-in. anchor bolts. In alternate bays both ends of the beams are bolted to the caps through slotted holes to provide for expansion, while in succeeding alternate bays the bolt holes are round and the beam ends consequently fixed. The roadway slab is detailed in Fig. 9, as is also the pipe railing. By designing the top railing as continuous rather than as simple spans between posts, an estimated saving of 18 tons of pipe resulted.

Deep Water Piers—The concrete piers under the plate girder spans consist of two battered square columns connected by a diaphragm wall, all resting on two clusters of six 24-in. concrete piles capped by two 12x8x5-ft. pedestals.

Each of the two lift span piers, built in open cofferdams, consist of a 52x28-ft. base, 15 ft. deep, resting on 200 untreated wood piles 65 ft. long. The pier bottom is 45 ft. below water level. Surmounting the base are two battered square columns connected by a 3-ft. diaphragm wall, all heavily reinforced. The bridge seat is 79 ft. above the base block and 49 ft. above water level.

Two 10-ft. concrete bell caissons extending approximately 36 ft. below water level form each of the 210-ft. truss span piers. The cylinders bell out to 23 ft. in diameter in the lower 8 ft. Above water level the cylinders reduce to 8 ft. in diameter and are connected by a 2½-ft. diaphragm. Each caisson rests on 40 wood piles.

Lift Span—Spanning a distance of 300 ft., the vertical lift bridge, direct-drive operated, is unique in size for this type of highway structure. The span rises 95 ft. from a closed underclearance of 52.7 ft. to an open position 147.7 ft. above mean low water. The two trusses, on 26 ft. centers, are Warren type, with inclined top chords. A laminated wood floor of 2x8-in. creosoted lumber is used on the lift bridge, provided with a 1½-in. wearing surface of a patented asphaltic composition lumber.

Four 40-hp. motors, two at the top of each tower, operate the lift by direct drive through the tower sheaves. One motor on each tower is for normal service, the other for emergency use. The controllers on the motors are arranged to keep the span in a horizontal position throughout the entire movement. Each of the two counterweights weighs 234 tons.

The bascule spans on the Nansemond and Chuckatuck bridges are of the double-leaf rolling type, 110 ft. center to center of rolling axes. These spans have the same timber floor construction as is used on the vertical lift span. One 20-hp. electric motor in each leaf supplies the lifting power, supplemented by a hand-operated mechanism for emergency service.

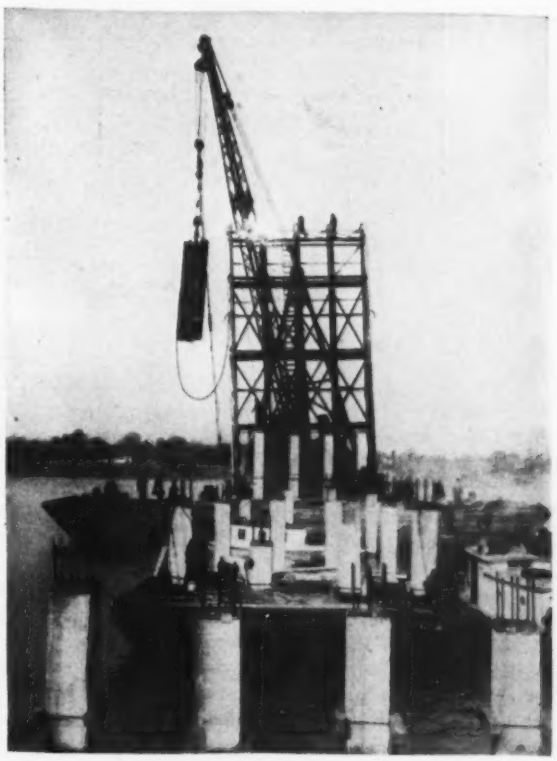


FIG. 4—FOUR-LEAD PILEDRIVER WORKING ON 88-FT. PILES, NANSEMOND RIVER BRIDGE
Piles in leads ready for driving. Two single-acting 7,500-lb. hammers in jack leads are used simultaneously. Illustration shows one of these hammers being placed in lead.

Construction Operations

Construction Schedule—Careful study of a construction schedule showed that the ultimate speed in completing the project depended on the speed in piledriving. The time needed for driving piles easily allowed time for completing the bascule, lift, truss and girder spans; and the pile capping, beam setting and deck pouring could progress at a much faster rate than the actual piledriving. Therefore the key to the progress of the entire project was in maintaining fast pile casting and driving schedules.

Main Base and Pile-Casting Yard—All concrete pile

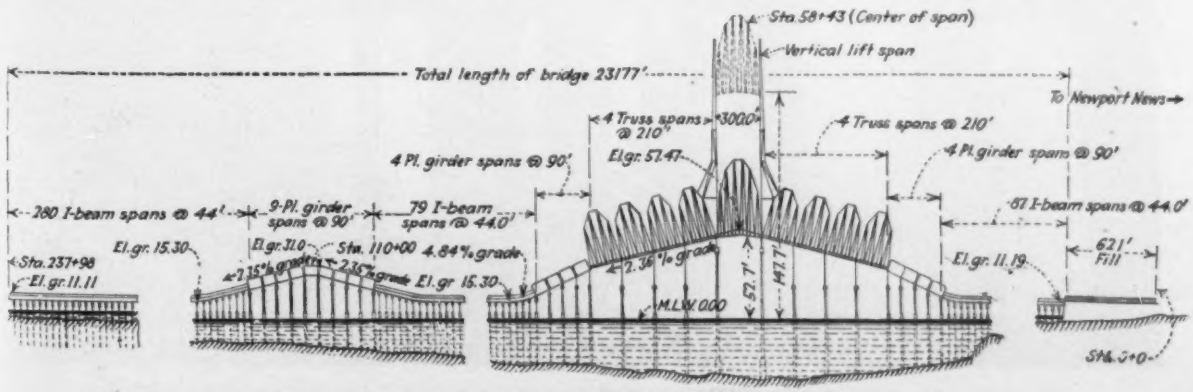


FIG. 3—PROFILE OF JAMES RIVER BRIDGE

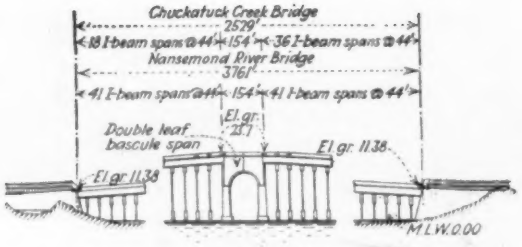


FIG. 5—PROFILES OF CHUCKATUCK AND NANSEMOND BRIDGES

casting and all possible preliminary field work was done in the main base yard established at Newport News, 4 to 8 miles from the bridge sites. The layout of the yard is shown in Fig. 11. All form lumber, reinforcing steel and I-beams were received in cars at the yard and unloaded here, stored and loaded out on scows as required.

A derrick boat unloaded sand and gravel received on scows into emergency storage piles to be used in case regular scow deliveries to the floating concrete plant at the bridges failed. Locomotive cranes unloaded the reinforcing and I-beams and did all of the car switching.

A feature of the job was a well-equipped concrete testing laboratory at the yard. Here an accurate record of each pour was kept and test cylinders were broken for the 7-day, 14-day and 28-day tests. All of the formwork for the deck slabs and pile caps and the pony bents was made up at the yard in panels and units in the carpenter shop. All of the reinforcing for the bridges came in straight lengths and was cut and bent to shape in the yard by power cutters and benders, except that for the deck slab, which was bent in place in the forms by means of hickey bars, thus effecting a considerable saving.

The pile-casting yard maintained a schedule of 100 piles per week, and as a minimum 30-day storage was required before the piles could be driven the casting operations were carefully planned to fit in with the required driving schedule. The piles were cured in the forms for seven days before they were moved to the storage yard. The casting platforms had a capacity of 100 24-in. square piles and 40 18-in. square piles. The platform for the 24-in. size was made wide enough to accommodate the 115-ft. lengths. The pile lengths were determined in advance by test piles driven at short intervals along the bridge sites.

Pile Forms—Details of the pile forms are shown in Fig. 11. The foundation framework of the platforms consists of 2x4-in. stakes driven into the ground on 18x15-in. centers, carrying 2x4-in. stringers on 15-in. centers about 6 in. above grade. The forms in detail consist of a permanent bottom panel, movable side panels with 1¼x4-in. battens, and a movable separator unit comprising the top cove corner pieces of adjacent piles and acting as separators between the pile forms. A 2x4-in. foot block separates the side panels of the adjacent piles and is tapered so as to permit the panels to be pried away from the concrete. Frequent oiling and a little care in use made possible the use of the forms over and over again.

Covering the entire casting platform, reinforcing storage yards, pile-storage yards and the pile barge slip was a gantry crane of 127-ft. span, steam operated. The crane was arranged with a beam hanger adjustable to four-point pickup on the longer piles and a three-point pickup on the shorter lengths. The piles were picked up by T-bolts screwed into threaded plates embedded in the concrete, the bolts being turned slightly to destroy

FIG. 6—TYPICAL I-BEAM AND CONCRETE PILE TRESTLE SECTION, NANSEMOND RIVER BRIDGE
Three of the four general types of bents used are shown here. Note improved type of roadway light standard.

bond before the concrete set. The reinforcing for the piling was made up into cages in the steel yard and carried to place by the gantry. Some of the cages were 117 ft. long, the longitudinal bars being single members without splices.

Pile Yard Mixing Plant—The pile yard central mixing plant consisted of two 1-cu.yd. mixers fed by a batcher plant from a 400-cu.yd. overhead storage bin. A stiff-leg derrick unloaded the sand and gravel from scows in the small boat harbor and charged the hoppers. Reserve storage piles of sand and gravel were kept on the ground for emergency use. A belt conveyor carried the cement from the storage house to the mixing plant.

The concrete was conveyed to the pile forms entirely by buggies. A permanent buggy runway led from the mixing plant along one side of the casting platforms, and movable runways resting directly on the forms led from the main runway to the point of pouring. All concrete was mixed a full two minutes in an effort to secure as strong and impervious a mix as possible.

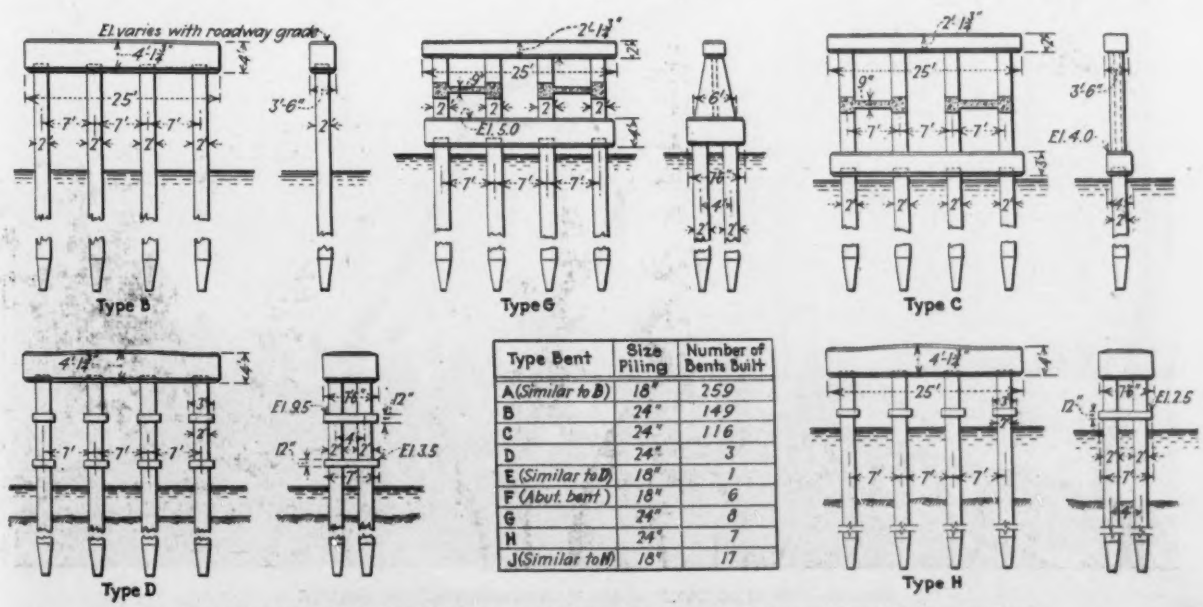
Piledriving and Trestle Building—The first operation in connection with the trestle building was to dredge a channel 180 ft. wide over the site of the three bridges wherever required to secure a minimum depth of 6½ ft. at low water. A 14-in. suction dredge was used in moving more than 350,000 cu.yd. of material, much of which was pumped to the shore and used in approach fills. At the south end of the James River bridge the material was pumped inland for a distance of 4,500 ft., to provide a roadway grade above the swamp level. The wide channel was necessary for the free manipulation of the many fleet units.

For the most part the piledriving was done with a four-lead floating driver, the same rig that was built for and used in the Lake Pontchartrain bridge (*Engineering News-Record*, March 29, 1928, p. 502). A view of this driver in action is shown in Fig. 4. The driver proved to be seaworthy, for while being towed from New Orleans to Newport News the rig broke loose from its tug during a storm off the Florida coast and was picked up later by a Coast Guard cutter, without suffering much damage. In operation, the driver is anchored with spuds, one at each corner of the scow,

FIG. 8—POURING PONY BENTS ON TOP OF PILE CAPS, JAMES RIVER BRIDGE
I-beams have been set temporarily on pile caps and used to hold pony bent form bracing.

and the four-lead unit spotted to transit points by a motor-driven ratchet and sliding plate arrangement on the deck. A 35-ton derrick on the driver picks up the pile from the scows with an adjustable sling taking an even bearing on the four pickup points. All four piles are placed in the leads before driving begins. Two 7,500-lb. single-acting steam hammers with a 42-in. drop were used simultaneously, thus driving the piles in pairs. The hammers, which were mounted in jack leads or guides, were handled from one lead to another by the derrick.

The piles were expected to be driven to a safe bearing load as indicated by the *Engineering News* formula. Some of the piles, however, drove very hard on account of sand pockets, while others drove very easy on account of mud pockets. In cases where the piles drove easy and there was any doubt as to their carrying capacity, they were tested by means of a 100-ton water tank. This tank was balanced on top of a pile by means of a heavy structural steel framework and was pumped full of water, the corresponding settlement being noted. On the average the piles were driven to a penetration of



Type Bent	Size Piling	Number of Bents Built
A (Similar to B)	18"	259
B	24"	149
C	24"	116
D	24"	3
E (Similar to D)	18"	1
F (Abut. bent)	18"	6
G	24"	8
H	24"	7
J (Similar to H)	18"	17

FIG. 7—TYPES OF CONCRETE PILE BENTS USED ON JAMES RIVER BRIDGE PROJECT

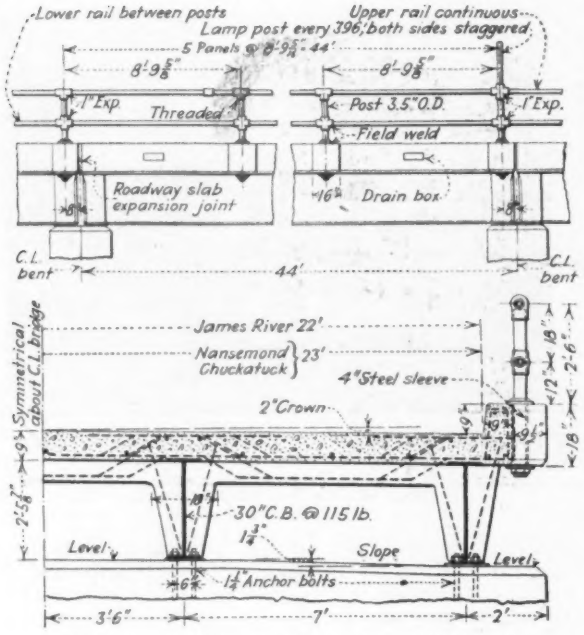


FIG. 9—TYPICAL ROADWAY SECTIONS AND ELEVATIONS

three or four blows per inch with the heavy steam hammers.

Approximately 25 per cent of the piles were required to be cut off to grade after being driven. For this purpose a floating compressor plant and air-driven hammers and chisels were used. Fig. 12 shows a crew at work cutting off piles.

After driving, the piles were again lined up and properly spaced by means of timber staybracing or yokes. This staybracing was also designed to support the forms for the pile caps. The caps weighed as much as 25 tons in some cases, and this weight was supported solely by friction between the piles and timber. The yokes were made up as follows: Two 6x6-in. timbers, placed transversely of the bent, were bolted around each pile. On top of these yokes was placed a 6x10-in. timber along each side of the bent, bolted tight against the piling, $\frac{7}{8}$-in. bolts being used for both sets of timber. The cap forms were built on top of the yokes.

The I-beams were handled from the supply barges to their place on the bents by a steam-operated derrick boat. Wherever the I-beams were to rest directly on the pile caps, they were set in their permanent position as they were unloaded. But in cases where pony bents were to be built on top of the pile caps the I-beams were set temporarily on the caps between the pony bent posts and used as bracing for the forms, as shown in Fig. 8.

Deck Forms—The deck slab forms were built up in panels to fit between the I-beams tight against the underside of the top flange. The panel forms were held in place by wooden horses set between the I-beams and resting on the top side of the lower flanges. Cleats nailed across the bottom side of the floor panels served as spacers for the horses. No wedges were used in holding the horses in place, which facilitated both erecting and stripping. The horses and panel forms were all framed at the base yard, and the field work was simply a matter of erection.

The slab width extending out beyond the outside beams was carried on forms built on brackets cantilevered out from the lower side of the beams. These brackets, built up of 6x6-in. timbers, were clamped tight against the lower side of the outside beams by means of hook bolts, and extended beyond the adjacent interior beam to bear against the bottom of this beam. Wedges were used on the outside sections to bring the forms exactly to grade. In stripping the forms it was a simple matter to knock out the wedges and remove the cantilevers, knock out the horses and remove them sideways, and lower the deck panels. It was possible to strip a

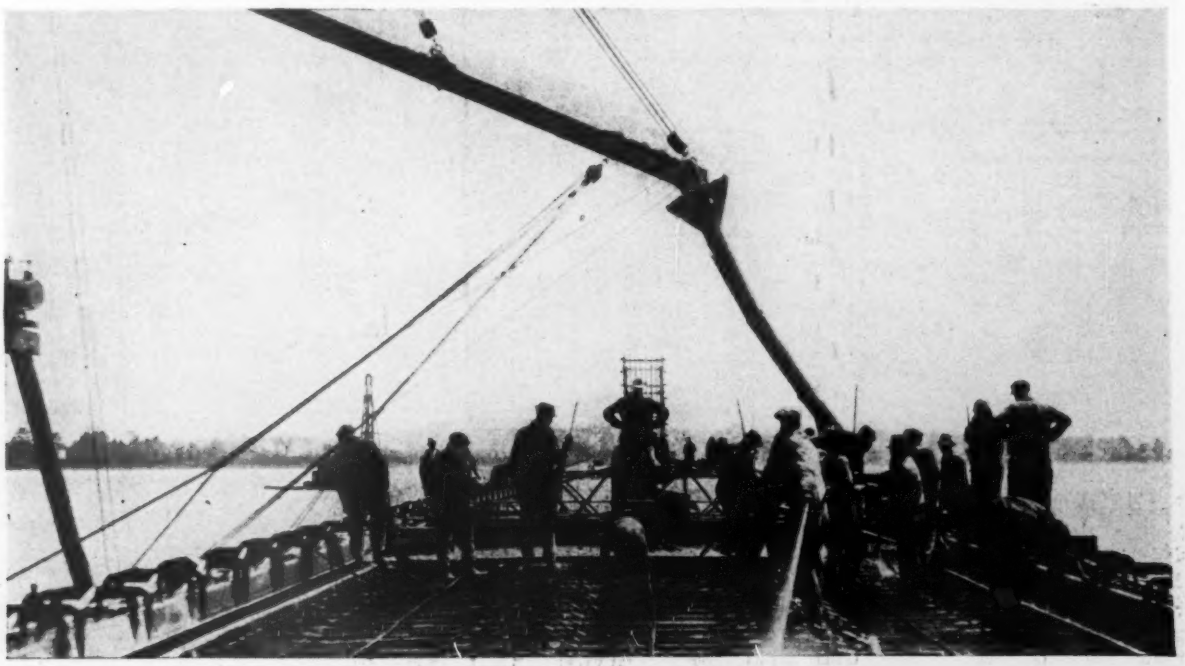


FIG. 10—POURING DECK SLAB, NANSEMOND RIVER BRIDGE
Mechanical screed used to finish slab shown in action. Bascule span under construction in background.

44-ft. span complete in 45 minutes. Steel forms were used for the roadway curb, held in place by clamps.

The roadway concrete was poured directly in place by the use of short sectional spouts hung from the concrete plant tower chutes. The deck slab was finished by a gas-driven mechanical screed, such as is used on highway work, adapted to the 22-ft. roadway width. The screed traveled along tubular steel rails supported on the outside beams by cast-iron chairs, and provided a satisfactory slab finish at a speed in keeping with the pouring operations. The screed is shown in Fig. 10.

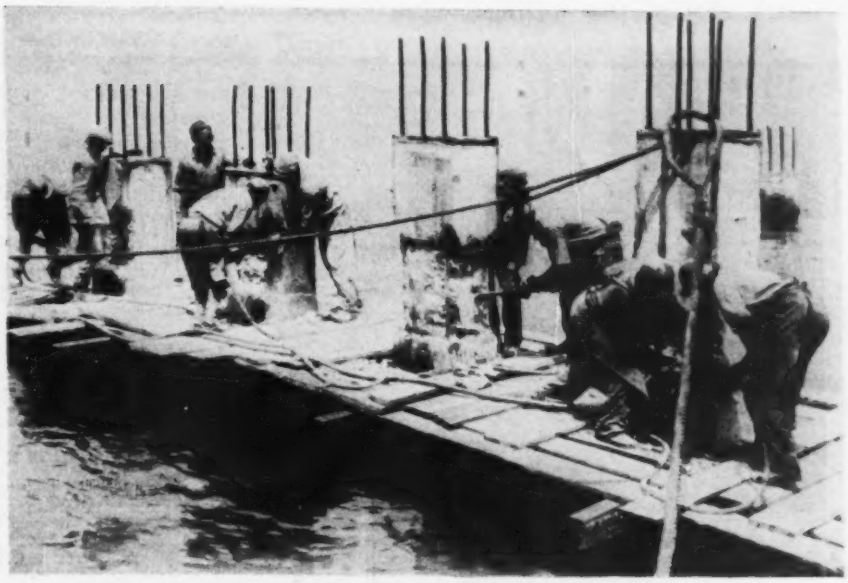


FIG. 12—CUTTING OFF CONCRETE PILING WITH PNEUMATIC CHISELS
Specially equipped floating compressor plant used for this work.

Deep Pier Construction—The lift span piers were built by the open cofferdam method. The pier sites were dredged to Elevation —45, then 60-ft. steel sheeting was driven around the cofferdam bracing, which had been previously framed as a unit and floated to place. Wood foundation piles 50 ft. long were driven to place through steel tubes without unwatering the cofferdam. The use of these steel tubes assisted in spotting the piles accurately and prevented them from deflecting out of line when striking hard sand pockets while driving. A 15-ft. seal constituting the base of the piers was poured with tremies. The cofferdams were then pumped out, and the pier shafts constructed.

The steel shells for the bell caissons were fabricated on shore and taken to the site as complete units. Fig. 13 shows these steel bells on the dock assembled. The sites of the piers were dredged 10 ft. below the river bottom and wood piling driven through steel tubes into the area to be covered by the bells. As the bells were sunk into place a driver inspected the bottom so as to be sure the cylinders were placed outside all of the piles. The cylinders were guyed to anchor piles by steamboat ratchets. The bells were sealed with 20 ft. of concrete, and then pumped out and the remaining concrete placed in the dry.

Steel Erection—The plate girders were floated into place and lifted into final position by derrick boats. The truss spans and the lift bridge were erected on wooden falsework resting on wood pile foundations. Floating derricks and travelers on the spans themselves were both used in the erection process.

Floating Concrete Plant—Two complete floating concrete plants were used in pouring the pile caps, pony bents and deck slabs. Each plant was mounted complete on a single 36x91-ft. barge. Each of the various pieces of equipment on board was operated by an individual gasoline engine, which proved to be a very satisfactory arrangement. Sand and gravel were unloaded from scows alongside to overhead hoppers by a stiff-leg derrick mounted on the rear of the plant barge and operated by an 80-hp. engine. Cement in bags was handled from a supply barge at the rear of the plant by a conveyor belt system operated by a 15-hp. engine. From the overhead hoppers the material went through a batcher plant to a 1-cu.yd. mixer. A 30-hp. gas engine operated the mixer. A 60-hp. engine operated a 1-yd. roller hoist bucket run-

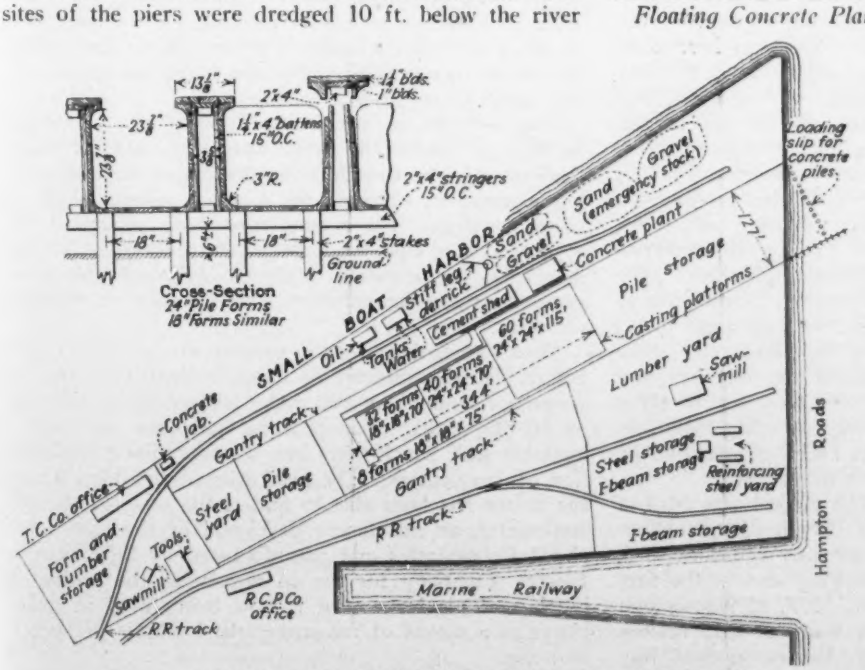


FIG. 11—MAIN BASE AND PILE-CASTING YARD AT NEWPORT NEWS JAMES RIVER BRIDGE PROJECT

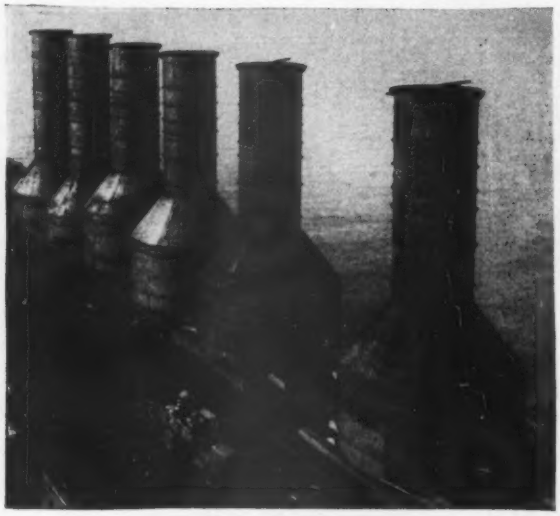


FIG. 13—PART OF SIXTEEN STEEL BELL CAISSONS ON DOCK READY FOR USE
Bells were fabricated complete on shore, loaded on barges and sunk to place at site as units.

ning up a 65-ft. wooden tower, where the concrete was dumped into a distributing hopper. From this hopper the concrete went to the forms through chutes hung by blocks and falls from the top of the tower, and carrying short sectional spouts at the end for final distribution. In pouring the deck slabs of the truss spans concrete buggies were necessary because of the interference of the trusses with the chutes. Another 30-hp. engine on board the plant handled the anchor winches and made the plant self-maneuvering for short distances.

Fresh water for the mixer was brought from wells on shore by water barges and stored in the hold of the mixing plant barge, and repumped to the mixer by gas-driven pumps. An electric generator of the farm lighting type supplied current for lighting the plant and to floodlights covering the work whenever night work was required. A steam boiler was used to supply heat to the plant, materials and forms during cold weather pouring.

Floating Equipment—The large well-equipped fleet made the fast construction schedule possible and permitted the close co-operation among the different construction operations that was necessary to maintain such a schedule. Some idea of the size of the fleet used on this project may be gained from the following partial list of floating equipment: one 14-in. dredge; eight derrick boats, some large enough to handle the 90-ft. plate girders; three complete floating concrete plants, two as described above and one used for the deep-water piers; six floating piledrivers, one with four leads; 30 power boats ranging from small launches to seagoing tugs; and 58 barges and scows of all descriptions for handling water, piles, I-beams, forms, steel and other materials. This does not include the barges and tugs operated by the sand, gravel and cement supply companies.

Contractors and Personnel—The project was built at a cost approximating $7,000,000 by the James River Bridge Corporation. The contract was signed Sept. 9, 1927, the first pile cast the following month, the first pile driven the last of December, 1927, at Nansemond River. The Nansemond bridge was put into service June 6, 1928; the Chuckatuck bridge was opened July 3, 1928; the James River structure was completed early in November, 1928. The whole project was opened with elaborate ceremonies Nov. 17, 1928. Two years had been allowed by the contract for completion.

The Turner Construction Company, of New York, was the general contractor, with R. C. Wilson, vice-president, in charge; D. M. Bartlett, general superintendent; and H. B. Pope, superintendent. The Raymond Concrete Pile Company, of New York, cast and drove the concrete piles. H. A. Christie was project manager, and George McGraw was superintendent for the Raymond company. Sanford & Brooks, of Baltimore, built the deep-water piers. The steelwork for the lift, bascule, truss and girder spans was furnished and erected by the Virginia Bridge & Iron Works, of Roanoke. The Newport News Shipbuilding & Drydock Company designed and built the steel bell caissons used on the deep piers. The concrete highway was built by the Roberts Paving Company. The J. E. Greiner Company, of Baltimore, was the consulting engineer on the entire project, with William Willoughby as resident engineer.

A Loudness Scale

How the Audiometer Scale Can Be Applied to Problems of Practical Acoustics in Building

By Wallace Waterfall
Research Engineer, Celotex Company, Chicago

Presents a practical measure of loudness and points out the essential difference between sound intensity and the quantitative sound sensation in its application to problems of soundproofing—so important in modern building work. —Editor.

THE thermometer furnishes us a very convenient and well-known means of designating heat level. The average person is familiar with the different sensations which accompany temperatures of 70 deg. and 30 deg. F. In the field of sound, however, there is no established scale of loudness, and in designating the loudness of a sound or the relative loudness of two sounds the average person has no means of explaining his sensation of hearing except by trying to reproduce it.

The architect or builder is still more at a loss when he tries to discuss the sound-insulating value of partitions or when he considers the effect of a sound-absorbing material in reducing the loudness of sound in an office or shop. These conditions have suggested the formation of a loudness scale which can be used for the discussion of acoustical problems in much the same manner as the temperature scale is used in thermal problems.

Most sounds dealt with in practice are not pure tones, but consist of a mixture of tones, ordinarily varying in frequency from about 100 cycles per second up to 8,000 or 10,000 cycles. For practical purposes we need a loudness scale which takes into consideration a combination of frequencies. The best scale of this kind which the writer has been able to find is the scale of the 2A audiometer, an instrument developed by the Bell Telephone Laboratories and manufactured by the Western Electric Company for use in measuring the acuity of hearing. This instrument is now being used in many places as a means of measuring the loudness of speech or noise.

It consists of (1) an electrical buzzer generating a sound containing frequency components corresponding

to average speech, (2) a resistance network, and (3) a special telephone receiver. The dial controlling the resistances permits variation of the loudness of the sound in the telephone. In measuring the loudness of any sound, the dial is adjusted until the buzzer sound in the phone is equal in loudness to the sound being measured. A small amount of practice gives surprising accuracy of judgment in determining equality of loudness.

The Scale and Its Grading—The scale of loudness, which we borrowed from the audiometer, is arranged so that the whole loudness range is divided into 108 divisions. The least sound which can be heard in a very quiet place is one unit. If we increase the loudness to a point where the sound becomes painfully loud, we pass from what is known as the "threshold of audibility" to the "threshold of feeling," and we shall find that we have gone through 108 steps. These steps are known as *sensation units*, and can be likened to the degree marks on the thermometer scale. By means of this scale and a knowledge of a few points on the scale which represent sounds we are accustomed to hearing, we can rate the loudness of any sound or noise.

The writer has made a great many measurements with the audiometer during the past few years, and the points presented on the scale (Fig. 1) are the ones he has found most useful.

Intensity and Loudness—Attention is called to the fact that the loudness and intensity of a sound are two different things. By intensity is meant the actual physical energy in sound, which might be expressed in terms of watts or horsepower or any other conventional unit of energy. Loudness is designated as the sensation produced in the individual by the intensity. The hearing mechanism is so devised that it does not respond in proportion to the intensity, but only in proportion to the logarithm of it. Therefore, the relation which exists between loudness and intensity is logarithmic.

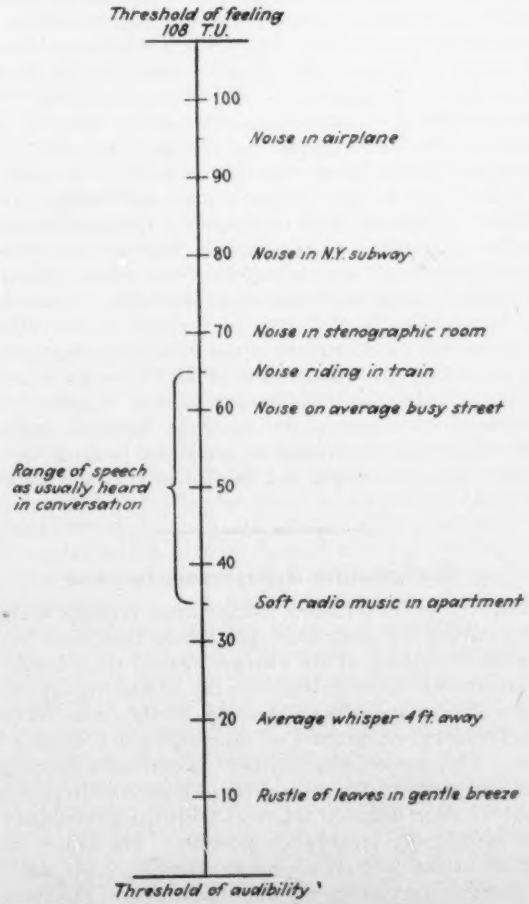


FIG. 1—THE SCALE AND SOME SIGNIFICANT POINTS

To illustrate the meaning of this, suppose we have two sounds, one having an intensity of 10,000 units and the other an intensity of 100 units. The first sound is 100 times as intense as the second sound, and yet it would be recorded by the ear as only twice as loud (logarithm of 10,000 = 4, logarithm of 100 = 2). It is evident that in practical acoustical problems we are not interested in sound intensity, but only in loudness. The scale (Fig. 1) deals with loudness in such a way that to the normal ear a sound of 80 sensation units (*TU*) on the scale would seem twice as loud as one of 40 units, and so on.

A study of the scale will show that the levels of loudness most commonly experienced fall in the central region. There are very few places of absolute quiet. Most rooms that are considered as very quiet have about 10 or 15 sensation units of noise in them. This is easily realized when we consider that 10 is about the noise caused by the rustle of leaves in a gentle breeze; a noise of this loudness is never heard in cities, because there are other noises loud enough to mask such a gentle sound. Noises at the other end of the scale are likewise uncommon. The noise in subways, such as those in New York, seems very loud, and yet it is only 80 on the scale. The fact that these two extremes are seldom found must be borne in mind in interpreting the results of various calculations.

Using the Scale—The application of the loudness scale to two types of problem is interesting. The first problem has to do with the use of sound-absorbing materials for quieting offices and other rooms. While the best-known use of sound-absorbing materials is in the correction of acoustical difficulties in auditoriums, the quieting of offices promises to become an even more important one.

In the correction of auditorium acoustics we are interested in and our calculations give us the period of reverberation in the room or the length of time which a sound will last by reflection from surface to surface until it finally dies out. In offices we are not so much interested in how much the absorbing material will reduce the reverberation in the room, but we want to know how much it will reduce the average loudness of the noise. A formula has been developed by means of which we can calculate the noise reduction and express it in terms of sensation units. Calculations and experiments have shown that it is usually possible to reduce the loudness of noise 5 to 10 sensation units by the use of absorbing materials. There are other effects produced by the use of absorbing materials in offices, but this reduction in loudness is a very important one.

At this point it should be mentioned that the reduction in *annoyance* caused by decreasing the loudness of noise 10 sensation units will depend upon the loudness level of the noise. This decrease in loudness in the lower part of the scale would not be expected to make much difference in annoyance. In the upper part of the scale, however, a change of 5 or 10 sensation units in loudness makes a great difference in annoyance. It is evident, therefore, that the reduction in loudness must always be considered with reference to the loudness level.

Soundproofing—Perhaps the most interesting application of the loudness scale is in the interpretation of

sound-transmission measurements. With the increasing construction of apartment buildings for residence purposes, the soundproofing of walls and floors has become very important, and we are repeatedly asked for figures on the effectiveness of various types of construction. Data now can be found on a number of constructions, but these data are expressed in such form that they can be interpreted only with difficulty.

In some of the most reliable data the "logarithmic reduction factors" of partitions are given, in units varying from 2.0 to 6.0, and an explanation is necessary to tell the average individual just what these figures mean. Other data show the "amplitude reduction" or "intensity reduction" which the partition will effect. Sometimes percentage figures are shown. Most inquiries for figures on sound insulation ask by what percentage sound will be reduced. At best the manner in which present sound-insulation data are presented is by no means simple, and in practice the writer has found that if all data are translated into the units of this loudness scale the whole subject is simplified.

Partition Tests—The writer has made a number of tests on partitions as they exist in actual construction by the use of the audiometer with certain accessory equipment, and has rated the noise reduction of the partition in sensation units. A partition which gives a reduction of 40 or 45 sensation units in the loudness of sound passing from one side to the other has been found to be a satisfactory partition for most purposes. The double tile wall as ordinarily constructed is approximately such a partition. The average loudness of conversational speech in a room usually will not be greater than about 55 units. This means that the loudness of a sound on the other side of the partition will be 10 or 15 sensation units (55 — 45 = 10); and, as already mentioned, there is enough extraneous noise in the room to mask a sound of such low loudness. It so happens that most of the present sound-insulation data can be easily translated into figures showing the sensation unit reduction of each partition, and then the use of the loudness scale helps interpret their meaning.

One point in connection with the interpretation of sound-insulation figures should be mentioned, because it involves a fundamental principle of the loudness scale. The principle has been shown by experiment and can be demonstrated mathematically. If we call the intensity of sound on one side of a partition I, and on the other side i, then the sound-insulation value can be expressed by the ratio I/i. In this way the intensity reduction can be expressed in percentage figures if desired. We are not interested in intensity, however. The ear registers *loudness,* which we have said is proportional to the logarithm of the intensity, and the reduction in loudness caused by a partition is as follows:

$$\text{Reduction in loudness (sensation units)} = 10 \log I/i$$

$$\text{Reduction in loudness (sensation units)} = 10 \log I - 10 \log i$$

The loudness of a sound, expressed in sensation units, is defined as ten times the logarithm of the intensity compared to minimum audible intensity. Therefore we can say:

Loudness reduction = Loudness one side minus loudness other side

The point is illustrated by the drawing, Fig. 2. Two partitions are shown, each of which has a sound-reduction factor of 30 sensation units. In the first partition we have a sound of 60 sensation units loudness on one side and the partition will reduce this loudness to 30 sensation units on the other side. The second partition, which is identical with the first, has a sound of 40 sensation units loudness on one side and this is reduced by the partition to 10 sensation units. In the case of the first partition the loudness of sound has been reduced 50 per cent, whereas in the second case it has been reduced 75 per cent. Both partitions are the same.

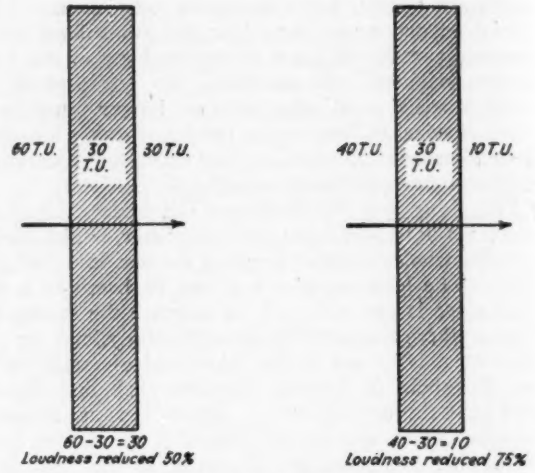


FIG. 2—EFFECT OF A PARTITION IN TWO CASES

This illustrates a fundamental principle of the loudness scale. Loudness reductions as caused by absorption or by sound insulation are all subtractive and are not percentage propositions. We cannot represent loudness reduction in either case by percentage figures without knowing the loudness of sound to be dealt with. Percentage figures on sound insulation are so commonly met with and yet so fundamentally unsound that this opportunity is taken to show why they should not be used.

Other uses of this loudness scale will suggest themselves. Wherever it is necessary to designate loudness levels or to speak of the relative loudness of different sounds, the scale is convenient. The writer claims no originality in the development of this scale. It has been made possible by the very fine work of Dr. Harvey Fletcher and his colleagues at the Bell Telephone Laboratories and by the experiments of Dr. Vern O. Knudsen at the University of California at Los Angeles. The writer merely wishes to introduce this loudness scale into the subject of architectural acoustics because he has found it so convenient and helpful in the interpretation of data.

Reclamation Repayments Increase

Settlers on government reclamation projects contributed during the past fiscal year more than ever before toward repayment of the charges against their lands, the Secretary of Interior states in his annual report to the President. Payments totaling $5,299,000 were made to the Treasury, an increase of nearly 25 per cent over last year. This marked improvement is attributed to the general prosperity of the project water users and to readjustment of their financial relations with the government so that satisfactory returns are possible. The report states that 24 of the projects are on an operating basis and that 22 of these are making regular repayments. The remaining two are expected to start repayments within about three years, according to their contracts.

Single-Hump Freight Yard, Texas & Pacific Ry.

Lancaster Yard at Fort Worth, Tex., Has Unusual Layout—Gravity Classification of Eastbound and Westbound Cars Handled Over One Switching Hump

RAPID growth of traffic accompanying the oil, agricultural and industrial development of Texas in recent years has made it necessary for the Texas & Pacific Railway to carry out a number of improvement works, prominent among which is the new Lancaster freight yard, at Fort Worth, Tex., established for the combined purpose of greater capacity and greater economy of operation. For the Texas & Pacific Railway, this city is not only an important division terminal and a junction point but is also an important interchange point, since it is served by nine trunk railroads. As the old freight yard was within a congested part of the city, any extension and enlargement was impracticable, while access to it was hampered by street and railway grade crossings on the connections to the main line.

Under these conditions it was decided to establish an entirely new yard in open country, where the layout could be planned for the most efficient operation and with provision for future expansion. An engine terminal was included, as is usual at large yards, but a less usual feature is the provision of shops and facilities for heavy repair work on engines and cars. This yard, which was put in service in March, 1928, one year after grading was begun, is about 3 miles west of Fort Worth, with a double-track main line from and through the city, although westward beyond the yard there is at present only a single-track line. In length, the yard is about 3 miles between end switches. It lies in a sag in the grade line, with ascending grades of 0.6 per cent to the east and 0.8 per cent to the west. About 1,100,000 cu.yd. of excavation moved into fill was required in grading the site. Along each side of the yard extend a main track and a run-around track.

At present there are about 50 trains daily in and out at the west end and 45 trains in and out at the east end, the latter being exclusive of transfer and interchange movements between the yard and the local facilities and industries in the city. A number of solid trains pass through the yard and require no attention except inspection, but most of the trains are broken up here, so that the number of cars passed over the hump daily for classification is about 1,100 and at times reaches 1,600 cars.

Basis of Yard Design—The yard layout, shown in Fig. 1, is unusual in some respects: (1) One double-track hump and one classification yard serve for classifying both westbound and eastbound movements, and this classification yard is divided into two sections used normally as separate units for westbound and eastbound cars respectively; (2) the eastbound and westbound receiving yards are parallel with and alongside of each other, at the west end of the yard; (3) eastbound and westbound advance or departure tracks flank the classification yard on opposite sides, being so located as to reduce to a minimum the distance required to move cars from classification to departure tracks.

The Lancaster yard comprises two distinct units: one for receiving, classifying and dispatching eastbound trains, and the other for similar service to westbound trains. In its arrangement it differs from the customary method in that the two receiving and the two sections of the classification yard in tandem with them are side by side and parallel. The eastbound and westbound departure yards are also opposite each other on their appropriate sides of the classification yard. They were purposely not placed in tandem with the latter, because, with the layout as now arranged, a much shorter and quicker movement of cars from the classification to the departure tracks is obtained. In connection with such movement more or less additional switching into proper order in trains is generally required.

Three major reasons controlled the design. First, the topography of the site and the existing grades of the main line provided a natural and economical location for a gravity yard for eastbound movement, as the west end of the receiving yard, which lies in a slight sag, is about 6 ft. higher than the hump. This plan minimizes the energy required to move full trains over the summit into the classification yard, which lies on lower ground to the east.

Second, while usually there is well-grounded objection to reverse switching movement of cars, as here required for westbound trains, in this case such objection did not obtain. This is for the reason that trains from the east, which pass through Fort Worth to the yard, consist of a very large percentage of cars which have to be returned to that city for interchange with other lines and for local delivery to house and team tracks and to industries. All of these, with the adopted arrangement, can readily be classified into the eastbound yard, combined with those coming from the west for same destinations and moved thence to the city. Third, it was quite apparent that with the adopted design, fewer switch engines would be required to do the work than if the two yards were separated, built in tandem and operated only in the geographic direction of arriving trains. The saving in switch engines more than compensates for the required additional train movement.

With this arrangement eastbound trains pull directly into the receiving yard, and the cars are passed over the hump into the southern section of the classification yard, from the eastern end of which they are drilled and assembled into trains in the closely adjacent departure yard. On the other hand, trains from the east, as well as local transfer and interchange cars from Fort Worth, leave the westbound main track at the east end of the yard and run over the westbound freight lead, passing around the north side of the yard to the receiving tracks at the west end. Their cars are then moved in reverse direction, or eastward, over the hump into the appropriate section of the classification yard, from which they are pulled out eastward. Those destined for the west are then pushed back into the westbound departure yard, while those destined to the city or for interchange with connecting railroads are put into the eastbound departure yard. All inbound engines, from either direction, as well as cabooses from the west, move over the run-around or thoroughfare track to the east end of the yard, where the engine terminal and westbound caboose tracks are located.

With the two tracks over the hump and with the classification yard divided into two sections, an eastbound and a westbound train can be classified simultaneously. Furthermore, as the switching leads below the hump are connected by a double crossover, cars from either of the

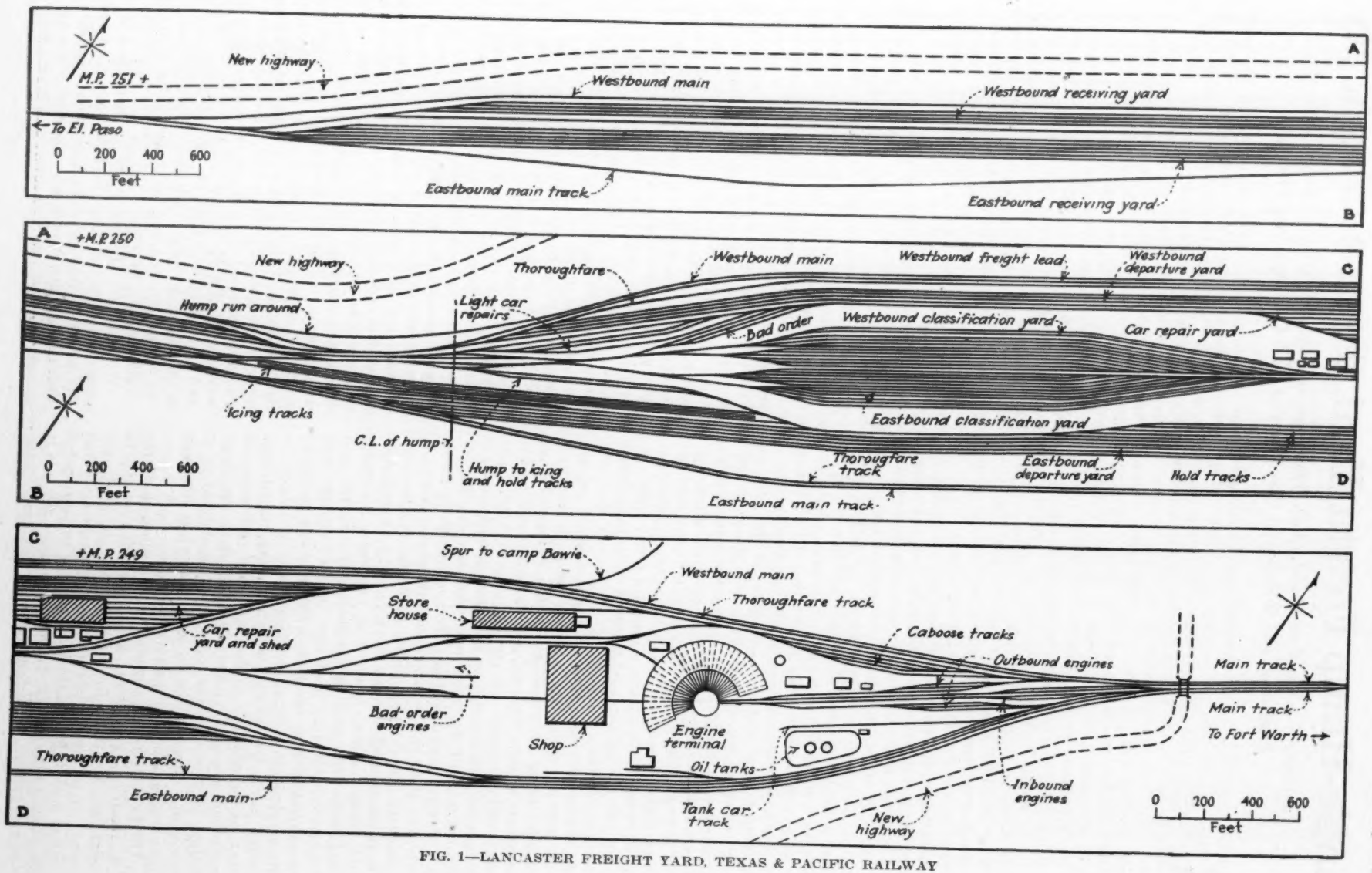


FIG. 1—LANCASTER FREIGHT YARD, TEXAS & PACIFIC RAILWAY

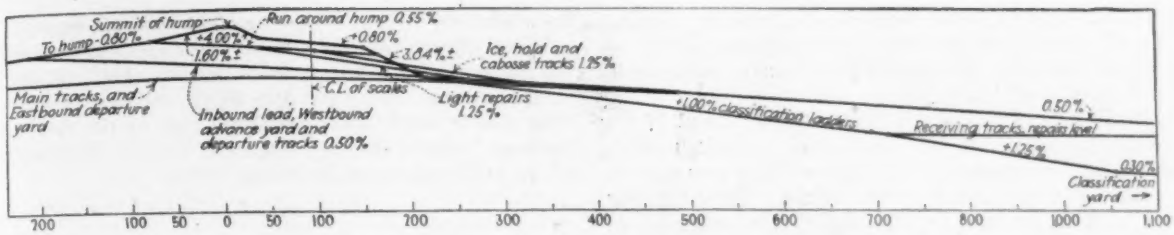


FIG. 2—PROFILE OF HUMP AND CONNECTING TRACKS

receiving yards can be switched over the hump into either one of the classification yards.

Each receiving yard has five tracks, each about 4,500 ft. long, or sufficient for a 100-car train with engine and caboose. One of these tracks is used as a thoroughfare track for the movements of road and switch engines. Each departure yard has five tracks of about the same length. The classification yard has 32 tracks averaging 1,550 ft. of clear length, or sufficient for 37 cars. Space is provided for four additional tracks, making a total of 36 classification tracks. By a multiple-ladder layout (see Fig. 3), with six main ladders serving the 36 body tracks, a preliminary separation of the cars coming from the hump is made promptly. This reduces the distance from the switches to the fouling points, so that the separate cars or cuts of cars can be run at closer intervals than when one long ladder serves a number of body tracks. In the receiving, classification and departure yards the body tracks are spaced 13 ft. c. to c.

Hump Profile—From the receiving yards, which are in a sag, there is an ascending grade of 0.8 per cent for about 1,700 ft. toward the hump, as shown by Fig. 2, this grade being increased to 1.6 per cent for about 80 ft. at the top in order to bunch the cars together for convenience in uncoupling at the summit. This summit is level for about 19 ft. and then a vertical curve runs it into the starting grade of 4 per cent, 25 ft. long. A grade of 0.8 per cent extends for 112 ft., including the scales, and checks the cars to the desired speed in weighing, after which a second accelerating grade of 3.84 per cent for 62 ft. runs into the classification ladders, which have a grade of 1 per cent for 500 ft. This is increased to 1.25 per cent for 243 ft. through the turnouts, beyond which the classification tracks have a grade of 0.3 per cent. Each hump track has a 250-ton plate-fulcrum scale 75 ft. long, with automatic weight-recording apparatus.

At the west end of the yard the main tracks, thoroughfare tracks, icing tracks and eastbound receiving tracks are practically level to a point beyond the hump, and have then a descending grade of 0.5 per cent eastward to the general level of the yard. The eastbound and westbound departure tracks have also a grade of 0.5 per cent.

While two trains can be classified at the same time, as already noted, the method of operation ordinarily is with a single hump engine handling either an eastbound or a westbound train and taking a full train of cars to the hump. These hump engines are of the 0-8-0 type, some of them having a booster engine geared to one of the tender truck axles. Lighter yard engines can do the drilling of cars from the classification yard and assemble them into trains on the departure tracks.

Car Retarder System—In planning this new yard it was decided to utilize mechanical control of the gravity switching movements, rather than to employ a force of car riders to handle the brakes on the descending cars. The entrance to the classification yard was designed, therefore, for a track brake or car retarder system. An all-electric system was adopted, in which the retarders, switches and track skates are operated directly by individual electric motors controlled by tower men. The layout of this system is shown in Fig. 3.

The installation is divided into three sections, controlled by three men in two elevated towers. The first operator, in one tower, controls the apparatus on the hump grade and on the two main ladders leading to the two sections of the classification yard. The two other men, located in the other tower, control the apparatus at the entering ends of the eastbound and westbound sections of the yard. At present there are 21 retarder units, 39 switch machines and 32 track skate machines. When the classification yard is enlarged to its full size, with 36 body tracks, there will be 21 retarders, 43 switch machines and 36 skates. The retarders on the hump are 22 ft. long. The others are 38½ ft. long, but at several points they are used in tandem pairs, as shown, giving a retarder length of 77 ft.

Switching lists for each train over the hump are sent from the yard office to the hump foreman, who directs the uncoupling of the cars, and to the three towermen, by means of pneumatic tubes. Each list shows the car number and destination of each car, in consecutive order, and also indicates which cars are to be weighed. Signals governing the movements of the hump engines and the

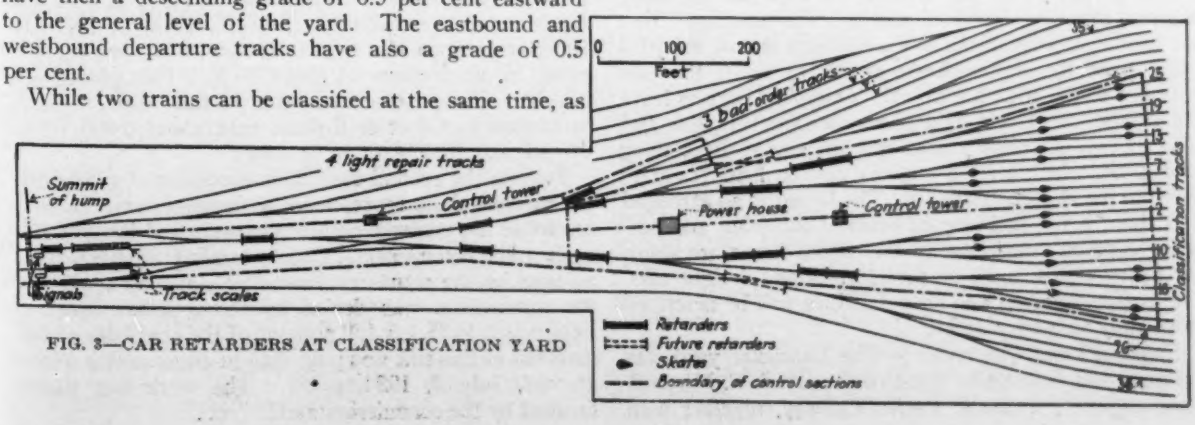


FIG. 3—CAR RETARDERS AT CLASSIFICATION YARD

switching engines in the yard are mounted on a bridge over the summit of the hump, with repeater signals on a bridge spanning the receiving yards at a point about 2,200 ft. west of the hump.

Auxiliary Yard Facilities—Near the west end of the classification yard are three bad-order receiving tracks, with a total capacity of 29 cars, into which cars may be diverted as they come from the hump. Those needing only light repairs are switched into a four-track repair yard, of 58 cars capacity, while those needing heavy repairs are moved to a car-repair yard adjacent to the shops. In both repair yards the tracks are in pairs spaced alternately 16 and 24 ft. c. to c. Compressed-air piping is provided for testing brakes and to serve pneumatic tools. Similar piping is provided also in the receiving and departure yards for testing brakes and charging the train lines of the brake system.

An icing platform 1,000 ft. long, between two tracks holding 22 cars each, is arranged near the hump. Practically all the icing done is for eastbound movements and the track connections are so arranged that full trains of cars in the eastbound receiving yard can be moved directly to the icing station, from which they may proceed to the departure tracks or may be moved back to the receiving yard for classification over the hump. About 100 cars are iced daily during the season of heaviest movement.

Floodlighting for night work is provided throughout the entire yard, there being 42 lamps of 1,000-watt capacity on six steel towers 80 and 100 ft. high. Some of these lamps are arranged specially for high intensity of lighting on the hump and classification tracks. To eliminate a highway loop with two grade crossings at the west end of the yard, the railroad company has built a macadam road along the north side of its right-of-way for a distance of about 8,000 ft., and has dedicated this road to the county. At the east end, a third road crossing has been eliminated by a road diversion with subway under the tracks; this road also was deeded to the county.

Main tracks are laid with 85-lb. rails and yard tracks with 85- and 75-lb. rails. Turnouts from the main and lead tracks have usually No. 16 and No. 11 frogs, while those for the body tracks have No. 9 frogs and 15-ft. switch rails. The sharpest curves on yard tracks are of 7½ deg.

Engine Terminal and Shops—The engine terminal facilities are located at the east end of the yard, between the main tracks, which diverge at this point, as shown in Fig. 1. All engines enter and leave this terminal at its eastern end. Two incoming engine leads run directly to the roundhouse. Alongside of them are two additional tracks giving room for a total of eighteen incoming engines awaiting terminal service. Locomotives from the train-receiving tracks at the opposite end of the yard move over the thoroughfare tracks to reach the east entrance to the engine terminal. Outgoing engines leave the engine lead tracks at a point near the turntable and pass to two outbound tracks and six engine-dispatching tracks, on which twelve engines can be held ready to move to the departure tracks. The layout is so arranged that there is no interference between incoming and outgoing engines. Adjacent to the engine house are shops for heavy repair work on locomotives and freight cars. The engine terminal and shop facilities will be described more fully in a later article.

Engineers and Contractors—The Lancaster yard was designed and built under the direction of E. F. Mitchell, chief engineer, Texas & Pacific Railway, together with his staff. F. R. Nayler was resident assistant engineer in direct charge of construction. Grading was done by the D. A. Foley Construction Company, Los Angeles, Calif., and tracklaying was done by the railway company. The electric car-retarder system is that of the General Railway Signal Company, Rochester, N. Y. Operation of the yard was begun in March, 1928.

Passaic Valley Sewer Builder Wins Claims Based on False Borings

Charles A. Haskin, Bankrupt by Contract, Unaware of Deception in Boring Sheets Until Successor Wins Suit

THE right of a contractor to rescind a contract on the grounds of misrepresentation of facts on the part of the engineers was again upheld in the recent federal court award of $612,566 to Charles A. Haskin against the Passaic Valley Sewerage Commission. Notice of the award appeared in *Engineering News-Record* Dec. 6, 1928, p. 855, and was similar to a decision rendered Holbrook, Cabot & Rollins in June, 1924 (*Engineering News-Record*, July 3, 1924, p. 21). Haskin was the second of a series of contractors engaged in building the outfall section of the Passaic Valley sewer serving a score of municipalities in northern New Jersey and terminating in New York Bay about 2 miles out from Bayonne, N. J. He went bankrupt nine years ago after a two-year futile struggle to carry out his contract. The award represented the difference between the actual cost and estimates paid to Haskin, plus interest, during the period of his work on the tunnel from 1917 to 1919. The suit was based on changes in the original boring sheets and misrepresentation by the engineers on the character of the material to be encountered.

Construction of the outfall tunnel section of the Passaic Valley sewer was begun by the O'Rourke Engineering Construction Company in 1915. The work involved was building about 15,000 ft. of concrete-lined tunnel, 15 ft. in diameter inside of excavation, through rock and soft ground from the east shore of Newark Bay in Bayonne to a terminal nearly 2 miles out in New York Bay. O'Rourke's contract was based on the use of free air, with provision for abandonment if this method proved impracticable. After two years of unsatisfactory work the contract was abandoned, and the loss sustained by the contractor was settled out of court for approximately $72,000 (*Engineering News*, May 3, 1917, p. 268, and *Engineering News-Record*, July 25, 1918, p. 191. In 1917 the contract was relet to Haskin, who contemplated using an air pressure of about 10 lb. This proved impossible. The contract was relet the third time, in 1922, to Holbrook, Cabot & Rollins, with about 6,000 ft. of the original 15,000 yet to be done.

Finding the ground conditions encountered widely different from those represented by the engineers, this firm rescinded the contract within two years and brought suit against the commission. Claims totaling $816,600 were allowed by the courts in June, 1924, and an appeal by the commission was denied by the appellate court in September, 1925. A full account of the principles of law involved in this suit was published in *Engineering News-Record*, July 3, 1924, p. 21. The work was finally finished by the commission itself.

Despite the discrepancy between the boring sheets and the materials encountered, Haskin was unaware that the borings were deliberately misrepresented until similar charges were made in the Holbrook suit, some five years later. The Holbrook case rested on deliberate misrepresentation through the boring sheet and oral information given by the engineers before starting work. The Haskin suit, based on a contract preceding that of Holbrook, charged that the material shown in the original boring sheets had been falsely reclassified to show more satisfactory conditions for tunnel driving.

The points involved are best shown from parts of Federal Judge Joseph F. Bodine's charge to the jury:

The contract drawings upon which he [Haskin] made his bids are an evident omission. He examined them and relied upon them. He called upon one Brown, who was then chief engineer of the commission . . . and was assured by him that the tunnel . . . was through a very compact material; that it would hold air well, and that the work would not require more than 10 or 15 lb. of air at the most. Brown, he said, said that a great deal of the work was to be done through "cemented triassic formation," which was a compact material which would hold air, and would require only 12-lb. pressure. He says that Brown stated to him that he knew that the triassic formation was there, because O'Rourke had found it. He was assured that the soil conditions indicated that he would be protected from water. He further says that Brown told him that O'Rourke had done it with low pressure, although, as a matter of fact, O'Rourke had been obliged to use 30-lb. air pressure and more.

Haskin has specified that as he went along he found no blanket of cemented triassic formation; that the air pressure had to be increased to 35 lb. . . . On Tuesday of each week . . . he called on Brown . . . who assured him, he says if he kept on he would come to the good material.

There has been much testimony in this case about the borings. . . . The charge is made by Haskin that these boring notes were changed, and that they were changed by the commission; that the original boring notes showed material far less favorable than the material shown after the changes were made; and that the disclosure upon these drawings as to the material found in these borings is quite different from that shown on the original notes. . . . The engineer for the commission specified that these changes were made by the engineers of the commission after the original boring notes had come into their possession; that they took samples and reclassified them; as they say, they reclassified them properly. Whatever the facts may be, they were changed, and there is a reclassification; and Haskin . . . testified that the material that was put upon the reclassified statement was more favorable for tunneling than the material that appeared on the original notes.

Haskin says that all these circumstances . . . as to the changes in the boring sheet and the failure to find the cemented triassic formation by other contractors came to his attention first in 1924, after the trial of the case of Holbrook, Cabot & Rollins. . . . The charge is that all the real facts were left off the drawings, and that the conclusions of the draftsmen or engineers were supplied for the facts as they came to the attention of the engineers for the commission; and the further charge is that these conclusions upon the contract drawings were not justified by the information which the commission had as to the soil conditions encountered by other contractors, by those who made the test borings, and that Haskin did not know what the other contractors had encountered, and he didn't know what had been revealed by the original boring notes.

His claim is predicated upon the fact that the law says: "That when a governmental body has asked for bids for excavation work, and has represented the condition of the materials to be excavated, and in its representations has misstated facts or has failed to state facts within its knowledge, it cannot escape responsibility by a clause in the contract in which it requires bidders to examine the work for themselves and in which it is said that its statements of facts were but expressions of its opinion and that it did not guarantee them."

The law, in effect, holds that representations made in such circumstances import a warranty, and that in consonance with familiar law, a person cannot contract against his own fraud.

There is, in this case, the further circumstances that the fact the field notes covering the test borings had been changed was not brought to Haskin's attention until after the trial . . . of 1924. . . . A deceptive representation is a misrepresentation of facts which deceive. It may also be an opinion, but only where the facts are not equally known to both sides; then the one who states the opinion may . . . impliedly state that he knows the facts which justify the opinion.

It is the contention of Haskin that these words "cemented triassic formation" as placed on the contract drawings indicated . . . that there was a layer of cemented material lying under the mud and sand of the river bottom extending to bedrock and through the line of the proposed tunnel. . . . The defendant maintained that the words "cemented triassic formation" so appearing on the contract drawing would not justify any reasonably skilled engineer in drawing such a conclusion, and that the words are synonymous with glacial drift. . . . It is their contention that Mr. Haskin understood very well what the meaning was, that he did not rely upon it . . . because it was a full, fair and complete disclosure of the true conditions encountered in making the test boring. . . .

Now let us run over some of the testimony. . . . O'Rourke . . . testified that he was commissioned to use about 10-lb. pressure. He found, however, that the material was very porous. . . . O'Rourke's original drawings showed material indicated on the original field notes. The field notes were changed. The changes alone are indicated upon the Haskin drawings and O'Rourke says that the material shown on Haskin's drawings are more favorable to tunneling than that shown on the drawings he had. . . . The commission's chief engineer knew that O'Rourke could not operate on free air and made a contract for compressed air. He never told Haskin about what he found. . . . The conditions which Haskin said he had encountered were found by Holbrook, Cabot & Rollins and by the commission to exist. In fact, they did not find the cemented triassic formation overlying the tunnel. . . .

A contract is a solemn undertaking, but it is in no sense of greater scope than the law itself. The plaintiff says that the law gives him a right to . . . relief—that is, right to rescind. The law says that one who has been induced by fraud to enter a contract may rescind it. The law also says that, where the contract has been entered into by reason of a mistake as to a material fact, the contract may be rescinded and recovery may be had by the party aggrieved for the reasonable value of the work and labor performed by him.

Every contracting party has an absolute right to rely upon the expressed statement of an existing fact, and he is under no obligation to investigate a verified statement to the truth of which the other party to the contract, with full means and knowledge, has deliberately pledged his faith.

I might also add . . . that a person who makes a representation of material facts, assuming or intending to convey the impression that he has actual knowledge of the existence of such facts, when he is conscious that he has no such knowledge, is as much responsible for the injurious consequences of such representation to one who believes and acts upon them as if he had actual knowledge of their falsity. . . . If the plaintiff knew that what was stated to him was false he was not deceived nor was there a mistake, nor was there breach of warranty for which he can recover.

Attorneys for the plaintiff were Thomas F. Conway and Thomas E. O'Brien, of New York, and Samuel J. Freedman of Boston. The defendants were represented by F. M. P. Pearse and C. M. Heine of Newark.

Six County Park Systems in New Jersey

Five counties in New Jersey have established or are now providing themselves with county park systems and one is organizing a park commission for the same purpose. When completed the systems of five eastern counties will make up in effect, though not in point of administration, a single New Jersey metropolitan park system. The Essex system was started 30 or more years ago and was followed by the Hudson system. Union County followed suit in 1921 and Passaic County since then. Quite recently organization of such a system was started in Bergen County. Across the state, the Camden Park Commission is already at work. The commissions are formed under general state law. They derive their construction funds from bond issues authorized by popular vote. Investment in land runs to many millions of dollars and in roads and other improvements to millions more. The work of the Union County Park Commission since its creation in 1921 is reviewed in the report just issued, illustrated with halftones and colored maps. W. Richmond Tracy is engineer and secretary of this commission, with headquarters in Elizabeth, N. J.

Need of a
National Hydraulic Research Laboratory

Success of Model Studies of Hydraulic Problems in European Laboratories Prompts the Hope That Congress Will Provide a Similar Establishment in This Country

By Blake R. VanLeer
John R. Freeman Scholar, A.S.M.E. (1927-28)

DEMAND for a hydraulic laboratory of a size sufficient to undertake the study of large problems such as those of river hydraulics continues despite the failure in the previous Congress of a bill providing for a national laboratory and despite the opposition of those who believe that the larger problems of river hydraulics cannot be solved in a laboratory. To disprove the latter contention, Mr. VanLeer, in the following article, points out what has been accomplished in the solution of similar problems in some of the larger hydraulic laboratories in Europe. —EDITOR.

IT FREQUENTLY requires a great catastrophe to bring us to a realization of how little we know about this world in which we live; of how essential it is that we continually test old ideas and old theories and experiment with new in order that a reasonable amount of progress may be made; and that it is the duty of each generation to contribute as much as possible to the meager store of human knowledge. This is as true of hydraulics as of other branches of engineering, and if the Mississippi flood of 1927 brings about a more searching study of our hydraulic problems it may not in the end prove as costly as it seemed.

The 1926 report of the Chief of Engineers, U.S.A., concerning the work on the Mississippi said: "It may be stated that in a general way the improvement is providing a safe and adequate channel for navigation and is now in condition to *prevent the destructive effects of floods.*" It must be borne in mind that this report was made with all of the available information at hand, with reports from some of the finest minds in the engineering profession; yet it is a matter of history that within six months after that report was published the Mississippi Valley was visited by the greatest flood on record. It is obvious that sufficient information was not available.

FIG. 1—SPILLWAY AT EITTING POWER PLANT, MITTLERE ISAR A.G.
Model studies were made on this spillway at the hydraulic laboratory in Munich and subsequent use has proved these test results correct.

The Mississippi River Commission district engineers, although almost unanimous in their approval of the use of a hydraulic structure laboratory, have always labored under emergency conditions which afforded little money or time for hydraulic laboratory research. The best proposal yet made for accomplishing this much-needed hydraulic investigation has come from the eminent hydraulic engineer John R. Freeman (see "The Need of a National Hydraulic Laboratory for the Solution of River Problems," *Proc.* Am.Soc.C.E., August, 1923, pp. 1185-1263), who has for many years advocated the establishment of a national hydraulic laboratory. In his proposal which he presented as his annual address as president of the American Society of Civil Engineers Mr. Freeman has covered

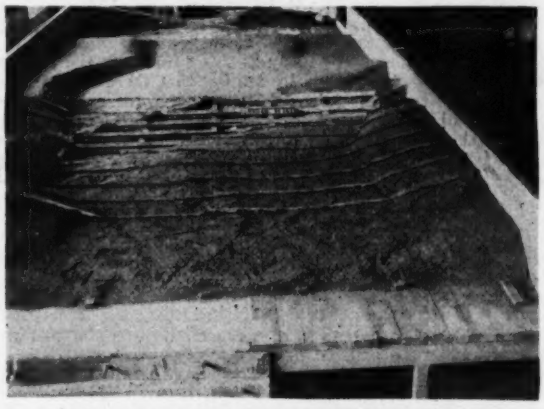


FIG. 2—A MODEL UNDER CONSTRUCTION
Showing the method of constructing hydraulic structure models in the hydraulic laboratory of the Technical University of Stockholm.

the matter so thoroughly and completely that a study of his paper is essential to those who are interested in this subject. This proposal has received the indorsement of many well-known engineers and no hydraulic engineer of any reputation has expressed public objection to the proposal.

The scientific method of investigation should be applied to the study of our hydraulic problems. That means in some cases the construction of small river models, but it means most of all the segregation of the variables in each problem by controlling the others, and slowly and carefully by experimental elimination finding the truth. It does not matter how many failures one may have in a laboratory; one learns thereby quickly and cheaply that at least that set of conditions will not work.

It is not to the credit of our profession that reputable engineers are continually charging that no scientific study or investigation has been made of the Mississippi River since the memorable work of Humphreys and Abbot. It is not to our credit that a dam like the Wilson dam

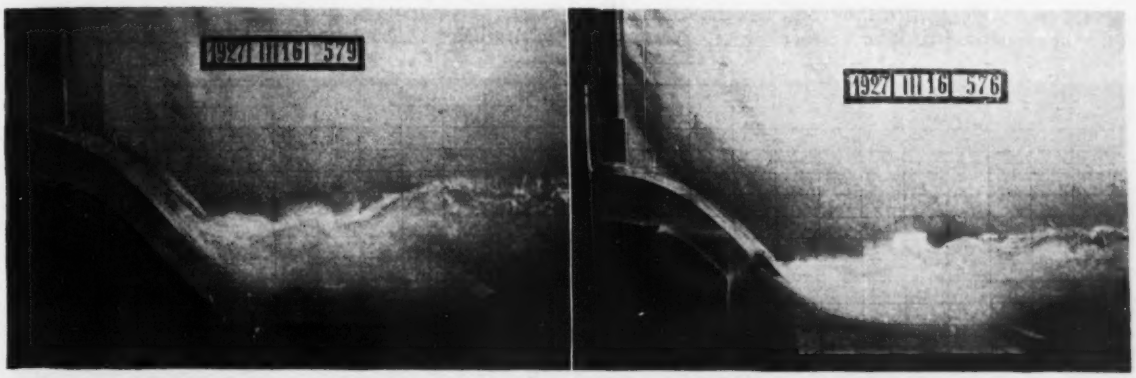
(see *Engineering News-Record*, Feb. 3, 1927) was constructed without model studies which would have predicted the erosion which subsequently occurred. It is not to our credit that America today lacks efficient laboratories in which studies may be conducted upon hydraulic structures. It is not to our credit that one of our foremost engineers who has contributed much valuable service to the Mississippi River Commission admits in published writings that the only way to tell what will happen to one of the gigantic spillways such as is now proposed for the Mississippi is to build it and see (see "Spillways," a paper by Col. C. McD. Townsend, May 11, 1925). Such openings for criticism should be quickly and permanently closed by the members of our profession joining solidly for the proposed establishment of *any means* which offers a reasonable hope for the extension of knowledge in our profession.

We have also the example of foreign countries. For the past twenty years laboratory studies upon hydraulic structures have been going on in Germany. One finds that model studies upon hydraulic structures have been successfully carried on in laboratories at Stockholm (see "The Hydraulic Laboratory of the Technical University of Stockholm," by B. R. VanLeer, *The California Engineer*, December, 1927), Charlottenburg, Karlsruhe, Dresden, Danzig, München (see "The Hydraulic Institute of the Technische Hochschule of München," Germany, by B. R. VanLeer, *Purdue Engineering Review*, March, 1928), Vienna, Brünn and Zürich. A description of these laboratories and their work will be found in "Wasserbau Laboratorien Europas," an English translation of which may be obtained through the American Society of Mechanical Engineers. (Reviewed by Clemens Herschel in *Engineering News-Record*, Dec. 20, 1928, p. 926.)

It is beside the point to argue that these laboratories have solved the problems of only small rivers, whereas our rivers are large. Of course the Mississippi is different, and that is exactly the reason it ought to be approached in the spirit of scientific investigation.

There is nothing revolutionary or radical about this proposal for a national hydraulic research laboratory. It means first the scientific attitude and method of approach, and then perhaps the visual study of many problems by means of glass flumes. The action upon many hydraulic structures is so complicated that it cannot be predicted by any known mathematical method. Also, it means the use of the law of dimensional similarity, which has produced so much progress in the field of aviation, shipbuilding and hydraulic machinery.

The possibilities of such a laboratory are illustrated by an enumeration of some of the problems that have been studied in the European hydraulic laboratories, some of which are pictured herewith. For instance, weir studies were recently conducted in the glass-walled flume at the hydraulic laboratory of the Technische Hochschule of Munich, Germany. In the same laboratory model studies were made of the spillway of the Eitting power plant of the Mittlere Isar A.G. prior to its construction (Fig. 1), and for more than three years the spillway has performed in accordance with the predictions made from the model studies. In the Stockholm hydraulic laboratory model studies were made of the Hammersfarsen dam in northern Sweden. The problem here was to determine the most effective means of discharging logs over the dam at the lowest construction cost. In the original design booms had been provided, as shown in Fig. 5. With this design the logs would have jammed at the boom protecting the inlet to the plant. The final and accepted design, in which the logs do not jam under any conditions, is shown in Fig. 6. The winds in the model tests were produced by a small variable-speed electric motor shown on the left in Fig. 6. These tests were made on a model the scale ratio of which was 1:200. The model cost 1,500 kroner and the engineers' estimate of the saving through the elimination of a large part of the original design was 250,000 kroner. (The rate of exchange is $1 equals 3.70 kroner, but the buying power is about 1 krone equals 50 cents.)



FIGS. 3 AND 4—MODEL STUDIES ON CHENDEROH DAM IN EAST INDIA

These studies were made in the hydraulic laboratory of the Technical University of Stockholm. Had the design shown in Fig. 3 (at left) been used, excavation to + 118 ft. would have been required. With the design shown in Fig. 4 (at right) excavation to only + 124 is necessary. The same quantity of water (proportional to 100,000 sec.-ft.) is flowing in both cases.

Fig. 7 shows a model of the complete Chenderoh dam to a scale of 1:96, in which the currents on the downstream side were studied. The model is 11.5 ft. wide and 20 ft. long, and the flow shown corresponds to a discharge of 25,500 sec.-ft. The maximum discharge of this dam is 350,000 sec.-ft., and the conditions of flow were studied quite satisfactorily. This flow is comparable to discharges expected over the Missssippi River spillways, hence there is every reason to believe that they could be studied in the same manner.

One of the most famous hydraulic laboratories in Germany is the Experimental Station for Hydraulic and Navigation Structures (Versuchsanstalt für Wasserbau und Schiffbau) at Berlin. Excellent examples of the work of this laboratory are the following, performed under the direction of Dr. Krey: Studies of the water channel currents at the Geestemünde harbor entrance at

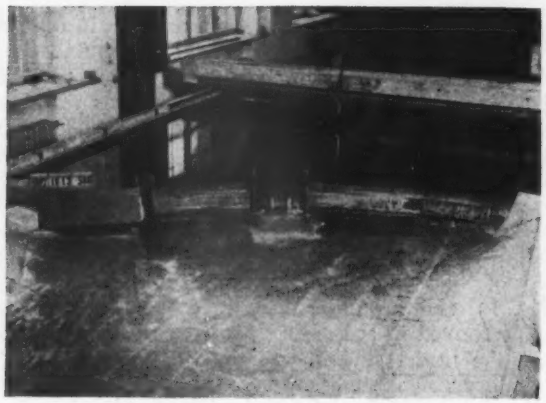


FIG. 7—MODEL STUDIES OF CHENDEROH DAM IN STOCKHOLM HYDRAULIC LABORATORY
Scale is 1: 96. Model is 11.5 ft. wide and 20 ft. long. Q flowing is 25,500 sec.-ft. Maximum Q studied was 350,000 sec.-ft.

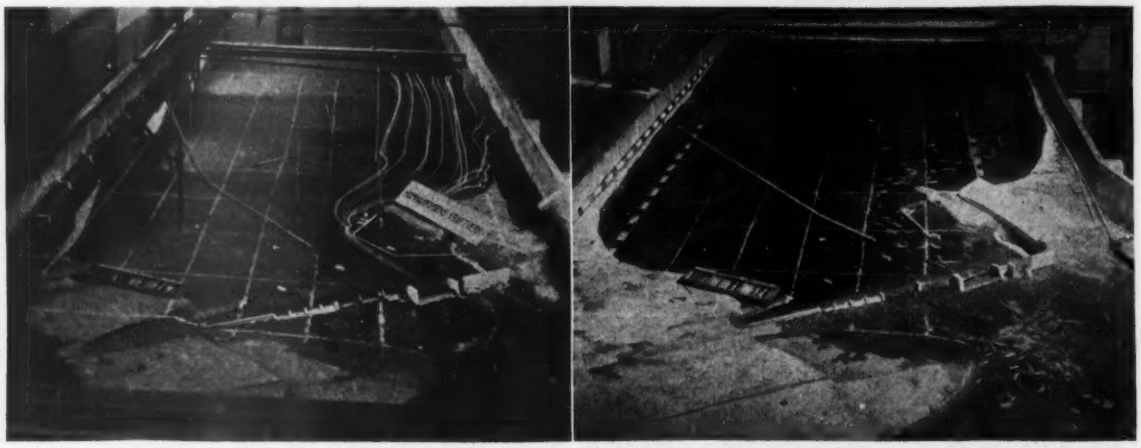
flood and ebb tides with different lengths of harbor moles. The purpose of these experiments was to find the location, form and length of mole which would give the least deposit of sediment at the harbor entrance; model studies conducted upon the Bremen harbor to determine the influence of the newly designed Columbus pier upon the River Weser. Besides the best location, form and length of the mole for the new harbor entrance, the best method of connecting this Columbus pier to those already existing was determined; river model experiments were undertaken to find a favorable low-water regulation for a section of the River Elbe.

Further and more numerous examples of the work of European hydraulic structures laboratories will be found in the *Journal* of the Boston Society of Civil Engineers, January, 1928, in an article by Germany's most distinguished wasserbau engineer, Dr. George H. de Thierry, entitled "Application of Laboratory Research to the Study of Hydraulic Problems."

However, the above examples of work should be sufficient to convince the most skeptical, first, that there is much valuable work which may be done in a national hydraulic research laboratory; second, that by the accepted American standard of measurement—namely, dollars saved—such work pays; and third, that it is our duty as engineers to give this proposal our hearty indorsement and professional approval.

The officers responsible for the policies of the Engineer Corps, U.S.A., have recognized the need for hydraulic research, and there is now before Congress a bill which has the indorsement of the Chief of Engineers, providing for certain funds with which to conduct hydraulic researches. There is also, in response to public sentiment on this subject, another bill before Congress providing essentially the same thing but placing the laboratory under the Bureau of Standards. It is hoped that Congress will in this session make some provision for the much needed investigation in the field of hydraulics.

The Corps of Engineers has prior to 1927 refused to countenance the recommendation for a hydraulic structures laboratory, but new leaders have now come into authority who desire to give the idea a trial. On the other hand, those civilian engineers who have given much time and thought to the question are of the opinion, first, that there is ample work for at least two such laboratories (Germany supports at least ten such laboratories); second, that there should be a governmental agency to which the civil engineer can bring his hydraulic structures problem for solution in addition to that provided for the government river and harbor work; and



FIGS. 5 AND 6—STOCKHOLM HYDRAULIC LABORATORY MODEL STUDIES OF HAMMERSFARSEN POWER PLANT
The model scale is 1: 200. In Fig. 5 (at left) the white lines are produced by lighted floats. Note that logs would have jammed at intake to plant. In Fig. 6 (at right) it will be noted that logs do not jam even with heavy wind from left. By the adoption of this design estimated saving in construction cost was more than $65,000.

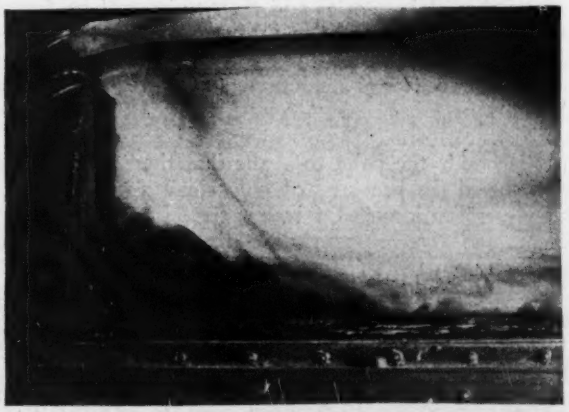


FIG. 8—WEIR STUDIES IN GLASS-WALLED FLUME AT HYDRAULIC LABORATORY OF TECHNISCHE HOCHSCHULE OF MUNICH, GERMANY

finally, that the Bureau of Standards, which is a scientific agency accustomed to similar work, should be intrusted with the task.

One of the most important problems with which a hydraulic structures laboratory could immediately and profitably concern itself is that of the stabilization of the banks of the Mississippi. All authorities are agreed that this is a desirable thing to do. The best method thus far developed is slow, expensive and not permanent. If a cheap, rapid and fairly permanent method of stabilizing the banks of the Mississippi could be found, considerable dredging could be eliminated with a vast improvement in navigability of the river; and certainly no serious thought can be given to shortening and straightening the river and thus increasing its carrying capacity until a cheap, rapid and fairly permanent method of stabilizing its banks is developed. The method of attack upon such a problem is obvious. One must first obtain accurately the exact velocities and conditions under which the banks begin to cut, then study in a laboratory the various suggestions for preventing this. After a method has proved satisfactory in the laboratory it should first be tried on a small river subjected to heavy floods, and if found successful there it can then be tried on the Mississippi. Such a procedure requires time and money, but if it could reduce the cost of the present revetment system from $300,000 per mile to $50,000 per mile and speed up the work tenfold and remain effective longer, there is no question concerning its value. And such knowledge would offer an entirely different possibility of handling the flood-control problem. It is because of such possibilities that the establishment of a national hydraulic research laboratory can be viewed so hopefully and enthusiastically.

Our Future in Hydraulic Research

This Country Formerly Led in Research—Full-Size Experiments in Germany Should Stimulate Similar Tests in This Country

READING Professor VanLeer's comment in the preceding article and his description in the August number of *Mechanical Engineering* of what Germany has done and is planning to do at Obernach in Bavaria in the line of hydraulic research may properly lead one to speculate upon the work that this and similar establishments, yet to be built in this country, may do in the future. To the writer the advance in hydraulic engineering research embodied in the Obernach testing station is the greatest that has been accomplished in such work since James B. Francis ceased experimenting in the 1850's in Lowell, Mass. In this country we may date the beginning of serious and exact work of the kind to what Francis then did and recorded in his "Lowell Hydraulic Experiments," a book only too little known in these days of too many inefficient experimenters dabbling in and mystifying what should be practical hydraulics, and too many hydraulic engineers not having the opportunity to work in lines of research needed toward the exercise of that profession. Herbert Spencer long ago said that "the value of an experiment depends upon the skill of the experimenter"; and reflection upon the wisdom of this saying will explain why so much that one sees in print does not advance the art of the hydraulic engineer, though put forth as the work of such and for such.

Hydraulic engineering is indeed a practical affair and task. Simple even in its ramifications, if one will only keep in mind its needs and applications, not permitting the introduction of tables, formulas, diagrams and discussion that have no aim, immediate or remote. Use is the test word for the engineer. He may be his own judge whether his work will ever lead to use for the craft, but he should keep that aim in mind when working and explain that what he is doing always points toward a given end.

Such work was done by Francis, "agent of the Proprietors of Locks and Canals on Merrimack River" for all of 50 years (about 1833-83), and included making the experiments that are recorded in the book that has been mentioned. I may add that several of his professional family have with more or less success endeavored to be his followers in such practical work and will ever try to have it continue to be done.

An establishment devoted to it is this of Obernach, in Germany. Its experiments are conducted, as it may be expressed, in life size. Models and tests of models are better than no tests at all, but the profession is ready to greet with gratitude the results of full-size tests of hydraulic operations. Such Obernach promises to supply. Incidentally be it noted that $350,000 has already been invested in the enterprise, and it will doubtless not be long before the invested cost will reach half a million dollars.

Something may be learned also from the manner of organization of this German National Hydraulic Observatory, to give it an American-sounding name, in place of attempting to translate its long-winded German name. Its stockholders are the German government, the Bavarian government and many of the principal hydraulic power plants of Germany. It is the hope that all the notable power plants of Germany will eventually take stock, and that these stockholders, as they are here called, not only contribute to construction costs but also bind themselves to make annual contributions to pay for costs of operation. Dividends they expect in the form of knowledge gained from the operations of the Observatory.

Can the United States compete by the endowment of a similar enterprise? It is hoped that they can.

Besides the projects now under discussion of hydraulic laboratories to be managed by the Bureau of Standards and by the Corps of Engineers of the army—by either, or one by each—many of our universities already have such laboratories, built and conducted on a small scale. There is room in our country for many more. The Harvard Engineering School is located only some 20 miles from the scene of Francis' labors, with the canals and waterfalls he worked on as actively in operation as they ever were and when they served his purposes. They should again be put to work, with sufficient endowment, and a hydraulic engineer (not a "scientist") and his assistants put in charge, to keep at work, exploring forever the endless realms of useful research, in the art of the hydraulic engineer. C. H.

Power Projects Recommended for Vermont Flood Control

Official Committee Reports Power Reservoirs Feasible Method of Controlling Flow of State's Five Major Streams

TO PREVENT a repetition of the disastrous flood that swept Vermont in November, 1927, causing the loss of 84 lives and property damage estimated at $25,000,000 to $30,000,000, the construction of power reservoirs on the five major rivers of the state is recommended in a report by the advisory committee on flood control to Gov. John E. Weeks. Regulating reservoirs are feasible, states the report, but they must necessarily be power projects as well, to be economically possible with Vermont's limited financial resources. The five rivers to be controlled are the White, Winooski, Lamoille, Missisquoi and Passumpsic.

The committee, consisting of J. W. Votey, dean of the engineering school, University of Vermont, as chairman; H. K. Barrows, Boston, Mass., as consulting engineer, and Harry Barker, consulting engineer, New York City, serving as secretary, was appointed by Governor Weeks, through the Public Service Commission, March 23, 1928, with instructions to have a report on flood control to present to the 1929 Vermont State Legislature. An abstract of the report follows:

Description of November, 1927, Flood—The flood and attendant damage were caused primarily by an unusual rainfall beginning during the evening of Nov. 2, and lasting from 36 to 48 hours. The storm was of the Atlantic coastal type but passed further inland than is usually the case, the storm path moving northerly across the State of Vermont. The maximum recorded storm rainfall was 9.65 in. at Somerset, Vt., 9.14 in. at Mollys Falls and 8.66 in. at Northfield, but it is probable that the total rainfall was as high as 12 in. in the higher portions of the Green Mountains. This excessive rainfall was preceded by heavy rainfall in October, so that the ground was already saturated, favoring a high rate of runoff at the time of the flood.

By the afternoon of Nov. 3 many of the rivers of the state were at destructive flood stages and most of the damage and loss of life occurred that night and the next day. The relatively steep slopes of most of the Vermont rivers, together with the excessive runoff of the streams, resulted in destructive velocities occasioning widespread damage. A total of 84 lives were lost in Vermont.

Estimated property damages are given in the following table:

Item		Damage
Agricultural—690 farms		$1,350,156
Highways:		
Roadways	$2,483,916	
Bridges (1,258)	4,579,082	7,062,998
Railroads—twelve steam and electric		3,901,200
Industrial—125 plants		5,558,800
Cities and villages—property		6,121,151
State hospital, Waterbury		400,000
Telephone and telegraph companies		319,050
Gas companies		30,400
Total		$24,743,755

Later figures, taken from a report of the American Railway Engineering Association, give the railroad loss as $8,578,000, including $2,731,000 as lost revenue.

The probable total damage resulting from the flood, including items not known about, was $30,000,000 or more.

By river systems the greatest damage occurred on Winooski and White rivers, although on nearly every river but the Deerfield more or less damage occurred.

Summary and Conclusions of Consulting Engineer—The only feasible method of diminishing flood flows in Vermont consists in constructing reservoirs for power use. As shown by experience on the Deerfield River, these are well drawn down by the fall of the year, when great floods are most likely to occur, as shown by records of the past. Hence automatically they act to prevent floods. Every power reservoir on a river helps to lessen flood tendencies and by developing comprehensive reservoir systems the flood hazard may be reduced to a minimum and at the same time the cost carried by the accompanying power developments.

Even when power storage reservoirs are filled, which is normally for about two months in the late spring, with the storage capacity available above the spillway level and adequate gate control to anticipate unusual rainfall, reservoir systems will still function to prevent floods, assuming competent and adequate operation.

The planning of comprehensive storage and power developments for each river system has developed therefore as the basic feature of flood control for the five large rivers on which work is contemplated—the White, Winooski, Lamoille, Missisquoi and Passumpsic. These have been thoroughly surveyed and studied with this end in view.

Following is a summary of the more important results of the investigations made of the five rivers for which work has been completed:

1. Upon all of these rivers storage capacity has been found sufficient to practically eliminate the flood hazard, assuming operation under competent and adequate control.

2. Reservoir systems have been worked out that will build up the low-water flow to such an extent that these may all become dependable power streams. This means that all plants on the river below will be of increased value, due to the resulting steady power which will be available.

3. The development of power at and near reservoir sites can in nearly all instances be accomplished at low cost and provide a return which will, in most instances, carry the cost of the reservoir.

4. It has been possible to work out for each river a comprehensive plan for storage and power development, including available head at reservoir sites as well as at other power sites on the river below, that will provide power at reasonable cost—varying between ⅜c. and ⅞c. per kilowatt-hour (including all fixed and operating costs of reservoirs and power developments, including land and property, but without allowance for special water rights) and as low as ½c. per kilowatt-hour in some cases.

5. The total plant capacity for these five rivers fully developed would be about 280,000 hp. and they would afford nearly a billion kilowatt-hours yearly—largely primary power. This is of course at present far beyond market possibilities.

6. As the market for power grows these storage and power systems may be developed, selecting the better projects first, but adhering to the general scheme as further developed by more detailed studies. It would be a long-time program, but when carried out would result in rivers highly developed for dependable power and free from disastrous floods.

7. Some of the summarized details relating to storage and power results are:

(*a*) Three thousand nine hundred square miles of river basins are included in the five rivers, or 40 per cent of the area of the state. Of this area, 3,319 square miles will have storage control.

(*b*) Storage reservoir capacity proposed to high-water line totals 58 billion cubic feet, with 42 billion cubic feet up to spillway level, sufficient to regulate all these rivers as efficiently as is now the case with the Deerfield River.

(*c*) Power developments at reservoir and downstream sites to an amount of 280,000 hp. are proposed which would afford nearly a billion kilowatt-hours yearly—largely primary power.

The total head developed would be 6,785 ft., with about two-thirds of this on Lamoille and Winooski rivers alone.

(*d*) The estimated total cost of all reservoirs is $40,000,000; of all storage and power developments combined $74,000,000, or a total cost per horsepower of capacity of about $264 for all storage and power projects.

(*e*) The average cost of power is estimated at 0.8c. per

kilowatt-hour, including all fixed and operating charges for reservoirs and power developments, but not including allowance for special water rights.

8. To secure some immediate effect in reducing flood tendency the following initial program might be suggested:

White River—A single large project on upper White River affords 5.2 billion cubic feet of storage at a total cost of $3,600,000. At a further cost of $1,200,000 a 12,000-hp. power development, affording 46 million kilowatt-hours annually of power (75 per cent primary), can be constructed. This one reservoir would largely eliminate the possibility of floods on White River and would materially build up the low-water flow of White River and add as well to the Connecticut River below.

Winooski River—Reservoirs constructed on Jail Branch and the North Branch of the Winooski River, totalling 2 billion cubic feet capacity, would be of material assistance in lessening flood flow in Barre and Montpelier, at a total cost of about $1,900,000. These can both have power developments totalling 6,500 hp. of wheels and affording 22 million kilowatt-hours of power (60 per cent primary) at a further cost of $600,000.

Lamoille River—Reservoirs on two of the tributaries of Lamoille River, totalling 1 billion cubic feet of capacity, can be constructed for about $600,000. Power developments with 6,500 hp. of wheels would cost $700,000 more and give about 22 million kilowatt-hours yearly of power (70 per cent primary).

These reservoirs would make a good start upon the Lamoille River reservoir system.

Missisquoi River—Two reservoirs upon the upper Missisquoi River, totalling 1.5 billion cubic feet of capacity, would cost about $2,000,000. Power developments, with about 6,000 hp. of wheels, would cost about $430,000 additional and afford about 20 million kilowatt-hours yearly of power (50 per cent primary).

These reservoirs would practically eliminate floods in the upper river and reduce them materially lower down.

Passumpsic River—Two reservoirs in the upper Passumpsic River, totaling 0.8 billion cubic feet of capacity can be built for $1,500,000. A power development of 2,100 hp. can be built for $390,000 additional, affording about 9 million kilowatt-hours of power yearly.

These reservoirs would make a good start on this river in helping to reduce flood tendency.

The foregoing program summarized is as follows:

Total storage capacity:	
Below spillway	10.5 billion cu.ft.
Above spillway	3.5 billion cu.ft.
Cost	$12,900,000
Capacity of power plants	33,100 hp., or $390 per hp.
Million kilowatt-hours yearly	119
Cost per kilowatt-hour	1.13c.

While these are not the projects lowest in cost and hence not as good from the point of view of power production, they would be of material aid in flood prevention and might therefore be taken up in advance of the more attractive projects.

9. Investigations are under way by the committee on other important streams of the state, including the Black, West, Wells, Williams, Ottaquechee, Poultney, Battenkill, Clyde and Nulhegan river systems, and Otter Creek, etc. While the results will probably not be as striking as for the five rivers now completed, the indications are that substantial storage and power possibilities will be found here as well.

10. Detailed surveys and plans have been made of certain localities where special flood problems exist—at Bolton, Waterbury, Montpelier, Barre and Proctor. Special studies will be made at these points and at Johnson, to be presented in a later report.

The committee recommends that the investigations continue, eventually covering all rivers within the state.

Plan Irrigation Project in New Mexico

The state engineer of New Mexico has completed a preliminary investigation and report on a possible irrigation project located on the south side of the San Juan River in northwestern New Mexico. The general plan contemplates the irrigation of about 700,000 acres, which would, with the probable future development on the north side of the river and along the tributaries of the river in Colorado, under normal conditions utilize practically the entire flow of the San Juan River.

The main storage dam would be built across the San Juan River about 20 miles northeast of Farmington, N. M. Estimates have been prepared for an earth- and rock-fill dam having a maximum length of 8,000 ft. and a maximum height of 270 ft. The storage capacity of the reservoir formed by this dam would be 2,230,000 acre-ft., of which 1,780,000 acre-ft. would be available for use. The cost of the dam is estimated at $17,504,000, or $9.83 per acre-foot of available storage. Supplementary storage is proposed at three other sites.

The main canal for the project would have a carrying capacity of 5,000 sec.-ft. for a distance of 36 miles, of which 17,112 ft. would be tunnel. Estimates show that 15,052,000 cu.yd. of material would be moved in the construction of this canal. Four inverted siphons would be necessary. The largest of these, at Canyon Largo, would be 30 ft. in diameter and 6,400 ft. in length, of reinforced concrete, and would cost $2,103,840.

Treating the Heads of Wood Piles

IN PILE foundations for docks and buildings the conditions are often such that preservative treatment is not necessary for the greater part of the pile length, but is desirable for a few feet at the top of the pile in order to provide against possible future lowering of the groundwater level, since above this level the wood is subject to decay. Although there appears to be a field for such localized treatment, as noted in *Engineering News-Record* of July 12, p. 72, there has been no practical development along this line. The subject has received attention, however, and investigation reveals different methods which have been devised.

A process for treating pile heads after the piles have been driven and cut off was invented a few years ago by Ernest F. Hartman, now president of the Protexol Corporation, Kenilworth, N. J. In this method, which was used experimentally and also applied to piles used in widening a pier at New York, a cast-iron cylinder is telescoped over the head of the pile for the desired depth, and sealed with gaskets or packing. The top of the cylinder is closed by a cap having pipe connections for oil and compressed air. While satisfactory results were obtained, as reported in the 1921 *Proceedings* of the American Wood Preservers' Association, the experiments were abandoned on account of war conditions and were not resumed. In another process, developed by the Joyce-Watkins Company, Chicago, the pile heads could be treated by pressure in the company's regular retorts, but this has not been applied commercially. With piles treated in this latter way very little cutoff would be permissible after the piles were driven.

Neither brush treatment nor the non-pressure process of treatment by dipping the pile heads in open tanks of preservative are considered adequate for piling to be used in permanent foundation work.

Pile foundation practice now consists in using piles treated for their entire length or in using untreated piles. In the latter case the piles are cut off at a depth believed to be well below any future groundwater level, and concrete or timber is then built up on the piling, which may involve considerable expense for the material used between the pile cutoff level and the base of the structure.

Failure of Counterweight Tower Caused Bridge Collapse

Engineers Report on Hackensack Bascule—Initial Failure in Counterweight Tower of East Leaf—West Leaf Found on Point of Failure

DEFECTS in the counterweight supporting and bracing system caused the failure on Dec. 15 of the east half of the two-leaf draw-span bridge over the Hackensack River on the Lincoln Highway near Jersey City, N. J., according to the preliminary report of the special engineering board appointed to investigate the failure. The initial cause of failure, according to the report, was the breaking of the rear channel of the north counterweight tower, induced by overstressing, the effect of which was seen in a crack of some age across the north flange and part of the web. These views correspond to those expressed in the news account in *Engineering News-Record* of Dec. 20, 1928, p. 931.

As stated in the news account, the bascule consisted of two leaves 98 ft. long from trunnion to outer end and was about 48 ft. wide between trusses. It was designed by the Strauss Bascule Bridge Company, of Chicago, and is of its vertical overhead counterweight type. It was fabricated by the American Bridge Company and was erected under supervision of the New Jersey State Highway Department, which now maintains it, by the Stillman-Delehanty-Ferris Company, contractors, of Jersey City. The counterweight system (Fig. 1) is in the form of a balanced and articulated parallelogram over the tail section of the leaf. The rear member of this parallelogram consists of a concrete counterweight and a pair of heavy posts, one over each truss. Each post carried half the weight of the counterweight down to a pin in the end of the tail section of the truss. The front member or counterweight tower is a pair of fixed posts, one erected over the trunnion supports of each truss and just back of the trunnion bearing; from a pin in the top of this post a link extends to the top of the counterweight block, this link being parallel to the line connecting the trunnion pin with the tailpin. The fixed tower and the upper link, which under ideal conditions carry no load stresses but serve only as a wind frame, are light members, the tower being made of two 12-in. channels spread about 3 ft. at the base and connected by single angle lacing.

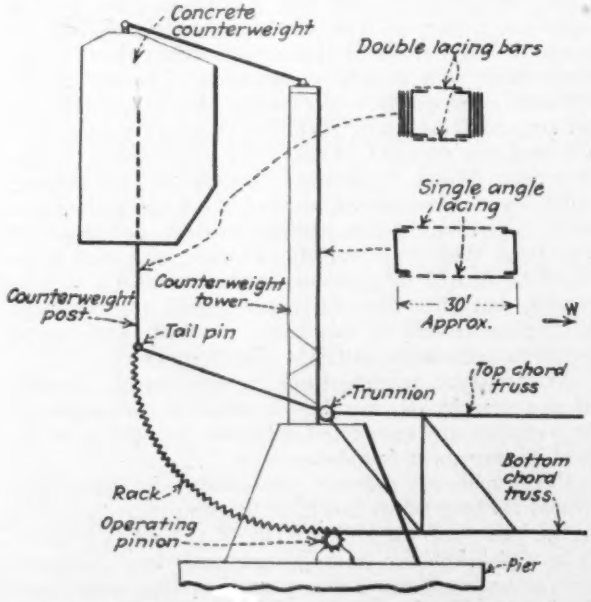


FIG. 1—SKETCH OF COUNTERWEIGHT SYSTEM OF HACKENSACK RIVER BRIDGE

The board during its investigation made extensive stress measurements on the undamaged west leaf and found it in a condition of potential failure. Check computations were also made to ascertain the magnitude of stresses in the east leaf at time of failure, while further studies, experiments and field observations are under way on the west leaf and will be subsequently reported upon. The preliminary report included observations on the failed east leaf, observations and stress determinations on the west leaf, computed stresses, conclusions as to cause of failure and recommendations as to reconstruction. The principal facts brought out in the engineers' report, which was signed by O. E. Hovey, assistant chief engineer, American Bridge Company; George E. Beggs, professor of structural engineering, Princeton University; and D. B. Steinman, consulting engineer, New York City, are given in the following abstract (partly paraphrased):

Observations on Failed Structure—The first failure occurred in the east channel of the north leg of the counterweight tower. The west channel of this leg was also fractured. The corresponding channels on the south counterweight tower leg had failed by sharp bending over or just above their connection to the top girder or the fixed part of the bridge upon the pier. These failures caused the counterweight to fall on the top chords, and it apparently skidded down the top chords, landing on top of the leaf in the river in a somewhat angular position and somewhat northerly of its original position.

The east channel of the north leg of the counterweight tower showed an old crack extending from the west toe of the north flange to an adjacent rivet hole and then from the east side of this rivet hole nearly ¾ in. toward the web of the channel; this crack was covered with rust. Adjacent to this and extending for about 2½ in. across the web was another crack made some time later but not long before the accident; this was discolored but not rusted. The new fracture extending over the remainder of the cross-section of the channel showed a typical tension-shear failure characteristic of failure of a relatively thin plate. The metal was bright, close grained and clean. The width of the channel was reduced from its original 12 in. by necking down; and necking of the south flange of this channel was also noticed. The failure of the west channel of this tower leg indicated good quality of metal.

There was no indication that the initial failure of the bridge originated elsewhere than in this north leg of the counterweight tower.

Observations on West Structure — The counterweight, which weighed 770 tons, was supported on two vertical columns resting on the tail pins in the rearward portion of the bascule trusses. These counterweight columns consisted of two 15-in. channels, each reinforced by three plates full width and joined by double lattice bars 2¾×⅜ in. The counterweight leaves about 6½ panels of lattice bars exposed to view. Practically all of these lattice bars were buckled either in or out, the maximum being about 1 in. from the original position. Also some of the batten plates at the bottom of these columns had buckled, one being dished near its center to an amount of 3½ in. These observations indicate that these columns had already commenced to fail. Both latticing and batten plates were inadequately proportioned.

While operating the west leaf slowly by means of the auxiliary gasoline engine drive, the counterweight tower columns deflected materially in an east-west direction. Six-hundred strain-gage readings taken on the counterweight

tower channels just above the top girders of the A-frame trunnion support showed a maximum variation of observed unit stress in an 8-in. gage length of 25,500 lb. per sq.in. One hundred observations by transit on the top of the counterweight towers showed a 0.48 ft. range of motion. Also these deflections corresponded to calculated stresses at the base of the counterweight tower reasonably consistent with the strain-gage readings.

Computed Stresses—The allowable maximum stress at the base of the counterweight tower was 11,600 lb. per sq.in.

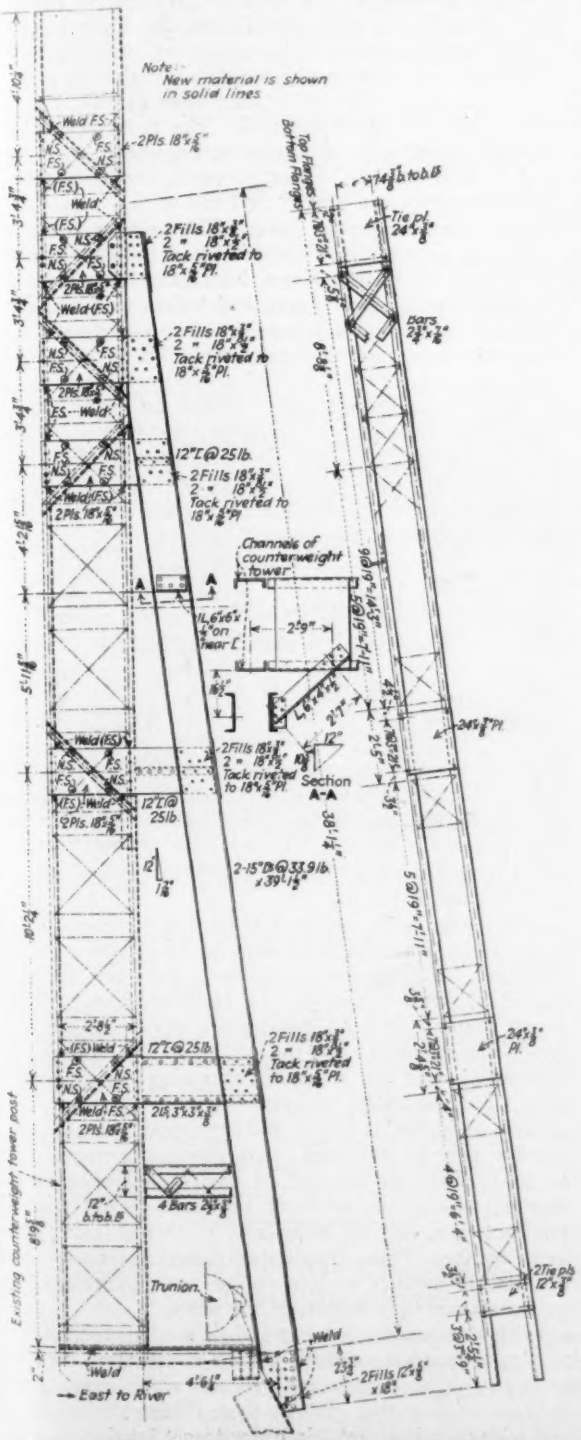


FIG. 2—NEW BRACING SYSTEM APPLIED TO NORTH AND SOUTH LEGS OF COUNTERWEIGHT TOWER, HACKENSACK RIVER BRIDGE

[This should be compared with the 25,500 lb. per sq.in. shown by the strain-gage readings.]

Assuming wind on the counterweight at 30 lb. per sq.ft., the wind stress equaled 19,800 lb. per sq.in. at the base of the counterweight tower when the leaf was in the down position. The torque produced by trunnion friction (co-efficient of friction of 18 per cent) will produce a stress of 9,600 lb. per sq.in. in the base of counterweight tower. The trunnion friction plus one-half the wind equaled 19,500 lb. per sq.in. when the leaf was moving. To this also should be added stresses from starting and stopping the counterweight plus stresses produced by the periodic motion set up by the combination of the pendulum effect of the counterweight and the elastic action of the counterweight tower. This periodic motion is very important in contributing to the total stress-producing effect.

Conclusions—Failure was due to inadequacy of strength of members in the counterweight supporting and bracing system. Initial failure occurred in the north leg of the counterweight tower and fracture of this tower leg had been progressive for some time. It is impossible to tell if the counterweight columns failed. It seems certain that imperfect lubrication of the tail bearing, that pier sinking and that any unusual method of bridge operation at the time of failure did not contribute to the cause of the accident.

Recommendations—The following recommendations are made as a result of our investigation:

1. That the west leaf be not operated for traffic until certain reinforcing operations have been carried out as described below.
2. That the counterweight tower on the west leaf be reinforced by bracing as shown in Fig. 2.
3. That the counterweight columns of the west leaf be reinforced in their latticing and batten plates. [The original latticing on these counterweight columns consisted of double lacing bars $2\frac{3}{4}$x$\frac{3}{8}$ in. The reinforcing consists of double lacing of the same size staggered between the existing lacing. Lacing bars 3x$\frac{1}{2}$ in. are used near the bottom of the columns, and the batten plates are reinforced by means of stiffener angles.]
4. That reconstruction of east structure include similar reinforcing.
5. That the engineering board supervise the reinforcing of the west structure.
6. That studies be made with a view toward permanently improving the efficiency of lubrication of the trunnions.
7. That the remaining fixed parts of the east structure be thoroughly inspected and checked for condition and alignment and all damaged portions be carefully renewed or repaired before these portions are used for the support of the proposed new east leaf.

These recommendations have been complied with and the bridge is now in operation, the east leaf being replaced by a temporary wooden trestle.

Airport Requisites

The voters of Kansas City, Mo., recently authorized the issuing of bonds in the amount of $1,000,000 for the purchase of an airport site. The following are the more important characteristics of the site, which in many ways is ideal. The "findability" of the site from the air is excellent, since it is located in a right-angle bend of the Missouri River with the confluence of the Kaw and the Missouri rivers at the apex of the angle. It is five minutes from the present post office and only fifteen minutes from the Union Station and the site of a new post office. It contains nearly 700 acres of flat land requiring only a minimum amount of grading. It can be protected from flood by simple and usual diking methods. It is accessible to concrete highways, and a railroad skirts the edge of the field. It is no more troubled with fog than other available sites. Its prevailing winds permit landing and taking off into the wind. It is now used by the U. S. air mail service.

From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Curb Corner Practice in New Bedford, Mass.

UNTIL a few years ago granite curb corners in New Bedford, Mass., were placed on an 8-ft. radius irrespective of the width of sidewalks. However, most of the city streets are narrow, and with increasing traffic the radii of the curb corners have been lengthened. The accompanying table shows the seven radii of granite curbing now standard in the city, according to L. J. Hathaway, Jr., assistant city engineer.

STANDARD GRANITE CURB CORNERS, NEW BEDFORD, MASS.

Radius	Number of Pieces to a Square Corner	Deg. Each	Length	Used for
8	3	30	4 ft. 2 in.	Patching
10	4	22½	3 ft. 11 in.	Two 8-ft. sidewalks
12	4	22½	4 ft. 8½ in.	8- and 10-ft. or two 10-ft. walks
16	5	18	5 ft. 0 in.	8- and 12- or 13-ft. or 10- and 12-ft. walks
20	6	15	5 ft. 2½ in.	Two 13-ft. walks
25	7	12½	5 ft. 7 in.	Special cases
32	8	11	6 ft. 3 in.	Special cases

Automatic Siphon Control for Small Water-Supply System

CONTINUOUS and automatic operation of a siphon in a water-supply system has been achieved by means of the device shown in the accompanying illustration consisting of a tilting platform upon which are mounted two tanks. Each tank is connected alternately to the siphon, and as the water runs from the tank, a sufficient vacuum is created to suck the air from the siphon. The device has been put into operation as part of a private water system with 93-m.g.d. delivery capacity, installed under the direction of J. G. Vincenz, Fresno, Calif., at Meadow Lakes, a residential country club in the Sierra Nevada Mountains.

An underground water supply was tapped by wells at the crest of a ridge near the upper boundary of the property and siphon-connected to the distributing system, which serves the cabins and golf course 200 ft. below and about a mile distant. The gases and air exhausted from the flowing water accumulated at the siphon bend above the wells, choking down the flow and requiring frequent priming of the system. In order to eliminate the necessity of a pump installation, the device for automatically relieving the siphon of air was developed. The two tanks are mounted on a frame which tilts so as to raise and lower the tanks alternately as they fill with water and are partly emptied. The tanks are suitably interconnected with admission and drainage water pipes and with air pipes, the first to admit and release water which operates the device, and the second to withdraw the air from the service main. The valves are operated by levers controlled by the tilting of the platform. In setting up the device it was found absolutely necessary to grind the air pipe joints and valves to a precise fit in order to insure a leakless line. The water flows from the tanks to a concrete basin about 30 ft. below filled with water above the inlet and discharge outlets in order to seal the pipe against air. When the connected tank is tilted to the emptying position, water flows through this pipe, establishing sufficient vacuum to withdraw the air accumulation from the siphon bend. Power for the gravity operation of the device is obtained at the expense of a moderate wastage of water.

DEVICE FOR AUTOMATICALLY REMOVING AIR FROM SIPHON BEND

Use of 4-In. Instead of 3-In. Tile for Partition Walls Saves Labor

By L. G. Reed

Superintendent, Morton C. Tuttle Company, Boston, Mass.

THE relative cost of terra cotta tile partition walls of 4-in. and 3-in. thickness were studied in connection with the carrying out of a contract in Scranton, Pa., recently completed. Conclusions showed the thinner tile was more expensive in the end due to the increased cost of placing.

The plans on this contract showed a considerable area of partition, specified to be built of 3-in. terra cotta tile, plastered. For this work ordinary three-cell 12x12-in. scored tile was purchased. In building these partitions it was found practically impossible to lay more than three successive courses of tile, the settling of the mortar when a greater height was attempted throwing the wall out of line. The procedure resorted to was to lay up three courses of blocks at a time and then move the masons to another part of the work, thus giving the mortar time to set. After an interval of two or three hours the mortar, which was one-third portland cement with 10 per cent lime, had set sufficiently to permit laying three more courses. This constant shifting of masons from one wall to another was expensive, and resulted in high unit costs for this portion of the work.

With this experience in mind, it seems probable that a 4-in. terra cotta partition can be constructed certainly more easily and quickly and probably more economically than one of 3-in. tile. Tile of these thicknesses is usually laid with cells horizontal in order to get bearing over the full thickness. The 4-in. tile weighs only about 1 lb. more than the 3-in. (16 and 15 lb., respectively), but

has 12 sq.in. of additional bearing. The difference in cost of the tile itself is less than 1c. per tile in favor of the 3-in. size. This additional cost would be more than offset by the saving in labor, as with 4-in. tile a height of 5 or 6 ft. can be laid in one operation without trouble. When estimating tile partitions, the cost of each is so close that it is the practice of this company to carry both 3-in. and 4-in. walls at the same estimated cost. The only possible advantage of the thinner tile is the saving of 1 in. in floor space, and this is so trivial as hardly to warrant consideration.

The Morton C. Tuttle Company of Boston held the contract on the work referred to.

Incinerator Refuse Can in Shape of Tree Trunk

IN ORDER to eliminate the necessity of daily collecting rubbish from refuse cans and to provide a receptacle rather more attractive than the usual refuse container, there has been developed a reinforced-concrete incinerator, designed to resemble the trunk of a tree, as shown in the accompanying illustration. They are

TREE-TRUNK TYPE INCINERATOR OF REINFORCED CONCRETE AS A SUBSTITUTE FOR REFUSE CANS

in use in a number of cities, about 350 of these incinerators having been placed in Central and Riverside parks in New York City, while the illustration shows one in use in Boston Common. Each receptacle is provided with a grate at the bottom, so that the park attendant merely burns the contents each evening. There are two holes directly under the grate to permit draft and to allow removal of ashes. The interior of the incinerator is lined with fireclay. These incinerators have been developed by the Municipal Products Company, Grand Central Terminal Building, New York City.

High Rock Unloading Record on Long Beach Breakwater

PROGRESS in building the breakwater at Long Beach, Calif., was controlled to a considerable extent by the rate at which rock could be unloaded from flat cars. The rock was delivered, usually in twenty-car trains, to the trestle from which the breakwater is being built and was unloaded by power shovels mounted on crawlers that move along on top of the flat cars, shoving off the rock with the bucket as they advance. The work as a whole was described in *Engineering News-Record*, July 8, 1926, p. 64.

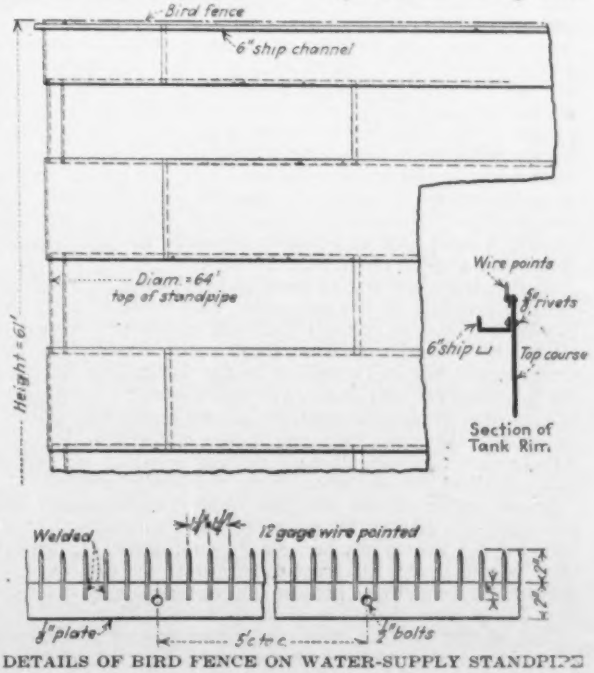
When work on the breakwater was begun, the expectation of the contractor was that rock could be unloaded at the rate of 25 cars per shovel per day. This rate was made almost immediately and was steadily increased until 40 cars averaging about 46 tons each became an ordinary eight-hour work for each shovel.

Competition among rival crews and a study of the fine points of the work made it possible sometimes to exceed considerably this average. The unloading record for a single shovel in an eight-hour period was 60 cars and the best eight-hour record for the two shovels on the job was 102 cars. This was not for selected sizes of rock, but included all classes, the average load on each car being about 46 tons. Rock sizes varied from the small quarry run up to pieces exceeding 20 tons in weight. The specifications call for five sizes of rock as follows: "No. 1, quarry run up to 300 lb.; No. 2, 25 lb. to 4 tons; No. 3, 1 to 5 tons; No. 4, 3 to 8 tons and No. 5, 4 to 15 tons. The tonnage unloaded monthly by the two shovels varied from 65,000 to 82,000, averaging about 72,000.

The work was done by the Hauser Construction Company, under the direction of Karl B. Kumpe, vice-president and general manager, and William Arndt, superintendent. E. M. Johnston was consulting engineer.

Wire Points Keep Birds Off Water-Supply Standpipe

A BIRD FENCE has been put around the top of a standpipe recently built by the city water system at Tacoma, Wash., and is functioning satisfactorily in keeping off the birds. The standpipe is 61 ft. high and 64 ft. in diameter, and previous experience indicated that its rim promptly would become a vantage point for the birds unless it were made unattractive to them. If the birds used the rim for a roosting point, their droppings in the reservoir would be objectionable on general



DETAILS OF BIRD FENCE ON WATER-SUPPLY STANDPIPE

grounds, if not actually producing an effect on the B. coli analysis.

The bird fence consists of 3-in. lengths of 12-gage wire sharpened at the upper end and welded to a ¼x2-in. plate which is bolted around the top of the standpipe. By placing the wires only 1¼ in. apart the rim is made unattractive to birds of a size that are likely to be this high above ground level.

Just below the bird fence a 6-in. channel iron encircles the tank as shown, serving as a stiffening member for the top plate course.

The Tacoma water department is under the general supervision of W. A. Kunigk.

Letters to the Editor

N.E.W.W.A. Cross-Connections Resolutions

Sir—The committee on cross-connections of the New England Water Works Association feels that in the interest of fairness and accuracy it cannot ignore your article and editorial in the Dec. 20 issue of your journal in which the final report of the committee is discussed.

The committee wishes first to call attention to the error and omission in the paragraph on p. 924, dealing with the personnel of the committee. Mr. King, not Mr. Chase, is an assistant superintendent of water-works. Furthermore, the water-works superintendents were also represented by Stephen H. Taylor, superintendent of the New Bedford water-works and past-president of the New England Water Works Association. This paragraph might have pointed out also that the viewpoint most heavily represented on the committee was that of the health authorities.

To the committee, the editorial seems quite unfair. In the first place, there is no justification for designating as weak the resolutions submitted with the report. As a matter of fact, the resolutions are stronger and more explicit than any other resolutions which have as yet come to the attention of the committee. It is probably true that no two members of the committee would have worded the resolutions exactly alike, and some would have been content with the setting up of a less rigorous ideal than that expressed by the resolutions.

Relative to "passing the buck" to the state health authorities, the committee would be interested to know the supreme authority which the *Engineering News-Record* would recommend to make the decision as to the quality of secondary water supplies. In resolutions of other associations no definite authority is designated as the final arbiter in this matter, although by inference these other resolutions would appear to leave the matter in the hands of the local water-works authorities. Does *Engineering News-Record* consider local water-works officials, by and large, the proper judges as to the quality of water? It seemed to the committee that inasmuch as someone must decide what constitute safe and unsafe, potable and non-potable supplies, the state health departments are the logical authorities.

Although the news item contains portions of letters from the two members of the committee who dissented from the resolutions on the grounds that the resolutions were too strong, the editorial does not point out this reason for the disagreement nor call attention to the interesting fact that the two members who objected to the resolutions in the form as presented were representatives of state health departments. In neither the news item nor in the editorial is the fact stated that at the well-attended meeting at which the report was submitted the resolutions were decisively indorsed.

In the matter of the vote, the committee recognizes but two legitimate courses for the membership to follow: (1) to vote for the resolutions because they represent a practical ideal in the matter of cross-connections; or (2) to vote against the resolutions because for one reason or another they do not meet the views of those in opposition.

The suggestion that three alternative sets of resolutions might have been presented for the vote did not and does not seem to the committee as constituting one of the purposes for which it was organized. Such resolutions could very easily have been prepared by interested members and presented to the association without the necessity of appointing a committee. As a matter of fact the resolutions finally presented were the strongest of any seriously considered by the committee during its deliberations.

FOR THE COMMITTEE,
ROBERT SPURR WESTON, Chairman,
E. SHERMAN CHASE, Secretary.

Boston, Mass.,
Dec. 31, 1928.

* * *

We regret that after having named and properly classified eight of the ten members of the committee Mr. Taylor's name was omitted as being one of the two superintendents on the committee and that Mr. Chase's name, after he had been properly classified, should have been substituted, by a slip of the pen, for that of Mr. King. The report did state that four of the ten members represented health authorities. The summary of the report and action upon it stated, in the first paragraph, that efforts to amend the resolutions failed and that the meeting voted to send the resolutions to letter ballot—which has since been done.

So much for matters of fact. The rest of the communication deals chiefly if not wholly with matters of opinion as to the strength or weakness of the resolutions and their suitability. The opinions we expressed on the general subject are in line with our attitude as to the elimination of cross-connections, before and since the appointment of the N.E.W.W.A. committee. The major part of our editorial comments dealt with interpretations that may be put on the results of the letter ballot.

As to "passing the buck" to the state health authorities: Instead of the association coming out flatfootedly against cross-connections with any water supply "bacterially unsafe" and then proposing administrative measures for the prevention of such cross-connections, the resolution throws the whole matter over on "the opinion of the state health authorities." The resolution does not recommend that state health authorities pass resolutions prohibiting cross-connections with unsafe supplies or, if legal authority to do so is lacking, that local water and health authorities join with state health authorities in seeking the requisite power from their respective legislatures. EDITOR.

Inspecting Welding

Sir—I notice with interest your editorial on "Welding Inspection" in the issue of Dec. 27, and as a contribution to the information on the subject of practical methods of inspection of welding, particularly in the field, I wish to say that our experience, which has probably been as extensive as most, has taught us:

First, that it is quite essential that the inspectors have some experience in welding with the various methods.

Second, that before proceeding with the actual work there should be some preliminary welds made and tested to develop whether the actual work when it starts can be produced or duplicated in the manner in which the best of the tests develops.

Third, there should then be welded small sample pieces similar in form to the parts of the structure which are to be erected, these samples to be of a size that the inspector can carry with him and use for comparison of the actual field work.

Fourth, at intervals there should be sample welds made in connection with the construction which could be detached and put through tests and examinations as a check on the uniformity of the work.

The foregoing indicates at least two things: First, that it is going to be some time before there can be anything like uniform data created which would be available for a guide either in the formulation of specifications or in carrying through the actual work; and second, that as in many other important engineering functions, the human element of the personnel engaged in the work is, as indicated in your editorial, very important. W. R. CONARD.

Conard & Buzby,
Consultants and Engineers
for Inspections and Tests of Materials.

Burlington, N. J.,
Dec. 31, 1928.

News of the Week

Cooper River Bridge Caisson Sunk to Place After Disastrous Tip

Cofferdam on Pier 10 Refloated When Tilt Traps Seven Men on First Day's Sinking

THE PNEUMATIC caisson for Pier 10 of the Cooper River bridge, under construction at Charleston, S. C., has been sunk to place and sealed after two successive tips, totaling 26 deg., had killed seven men during the first day's sinking, Dec. 1. The tipping was caused by one side of the caisson hanging on one of the 60-ft. guide piles which had unknowingly deflected into the caisson area during driving. All men in the working chamber escaped when the structure first tilted about 15 deg. from the vertical. After the caisson had shown no further signs of tipping during the rise and fall of a tide, workmen entered the chamber in an effort to dig under the high side to right the structure, only to have it suddenly list an additional 11 deg., trapping seven of the eleven workers.

Pier 10 is to carry the east end of the east anchor arm of the main channel cantilever span and is 55x18 ft. in plan, extending down to El. —80, or 80 ft. below water level. The caisson was built up of timber frame and timber sides, 90 ft. high, of which the upper 40 ft. was open cofferdam. Before starting sinking, the caisson timber framing and sheeting had been practically completed and about 38 of the ultimate 50 ft. of concrete had been poured. Borings at the pier site had indicated a stiff blue silt starting at the river bottom, El. —29, and grading to a firm blue clay at El. —56. This formation existed in an 11-ft. layer overlying a formation of marl, in which the pier bottom was to rest. Experience with other piers had proved the necessity of loading the caissons heavily at the start to cut through patchy layers of hard sand and cinders dumped by ships.

Cutting Edge Hangs on Pile

Actual sinking started at 7:30 a.m. on Nov. 30, when air was first turned on. After two hours' work the west cutting edge hung on a pile, tilting the caisson 15 deg. to the east. Although the working chamber filled rapidly with mud, all of the sand hogs reached safety. Five cables were at once thrown around the top of the cofferdam and tied to a completed adjoining pier on the west to prevent further listing. After waiting a full run of tides and no additional tilting having occurred, eleven men went into the chamber to clean out the mud and dig under the high side. At first the caisson showed signs of righting, but at 1:40 a.m. on Dec. 1 the structure suddenly tipped an additional 11 deg.

The bottom of the caisson kicked several feet to the west with the second tip, breaking off several guide piles, requiring that the structure be refloated and resunk to reach its correct position. The cofferdam was not flooded, as the sheeting had been completed to a point high enough to clear the water level, even after the tipping. About 18 ft. of the concrete was removed from the top by air drills, most of it being but a few days old. Removal of this weight allowed the caisson to float on Dec. 17, and sinking operations were again commenced the following day and were completed last week without further trouble.

Waddell & Hardesty, New York, are consulting engineers on the bridge, which is being built by the Cooper River Bridge, Inc., as a highway toll project. The Foundation Company, New York, is contractor on the deep foundation work, and the McClintic-Marshall Company is the contractor on the superstructure.

New Frisco Line St. Louis to Memphis Recommended

Tentative approval of the St. Louis Southwestern Railroad Company's plan to open a new direct route from St. Louis to Memphis by construction of 33 miles of new lines and the purchase of three short railroads was given in a report to the Interstate Commerce Commission by one of its examiners. The Frisco proposes to build new lines from Gideon to Deering, Mo., and from Hornersville, Mo., to Leachville, Ark., and to acquire ownership of the Gideon & North Island Railroad, the Deering Southwestern and the Blytheville, Leachville & Arkansas Southern. The new construction will cost about $280,000 and the purchase of the three small lines would amount to an additional $830,000.

Governor Asks $3,300,000 for Maryland Institutions

State loans totaling $3,300,000 for additions and improvements to state institutions have been recommended to the Maryland General Assembly by Gov. Albert C. Ritchie. Of this amount, $995,000 would go to the University of Maryland, including $100,000 for an addition to the engineering building. Land and the first unit of a new state penitentiary call for $730,000, and improvements at the Spring Grove State Hospital require $500,000. The remainder of the loan would be distributed among various other institutions in amounts from $6,000 to $133,000.

Road Builders Meet in Cleveland Next Week for Annual Conventon

Over 400 Exhibitors to Display 500 Carloads of Equipment in Public Auditorium

DELEGATES from 30 nations will attend the 26th annual convention of the American Road Builders' Association to be held in Cleveland, Ohio, Jan. 14 to 18, inclusive. Advance registration figures point to a new high attendance figure of 30,000. In conjunction with the convention the manufacturers' division of the association, representing more than 400 exhibitors, will display in the Cleveland public auditorium 500 carloads of the latest roadbuilding and general construction equipment. Preliminary to the convention proper, the manufacturers' division will hold a session on Saturday, Jan. 12.

The association's membership, classified as city officials, county highway officials, engineers, contractors or constructors, manufacturers and Pan-Americans, will convene in that manner, with special meetings for the different groups. Sunday, Jan. 13, will be devoted to receptions for delegates from outside the United States. Monday and Friday will be exhibitors' days with no meetings scheduled except those of committees. Tuesday will be city officials' day; Wednesday, Pan-American day; Thursday, county highway officials' day.

Mexico will have the largest foreign delegation, with Europe, South Africa, South America, China and Central America well represented.

University of Wisconsin Offers Short Concrete Courses

Short courses on the best modern concrete-mixing practice will be held in five Wisconsin cities by the University of Wisconsin with the assistance of the Portland Cement Association, beginning the middle of this month. The courses, given for the engineer, architect and contractor, as well as for the practical man, will be presented in the form of lectures and demonstrations at two meetings, with as much general discussion and questioning as possible. Proportioning by the water-cement ratio and by weight will be explained. The university will follow up the short courses with laboratory work at Madison and Milwaukee, open to all who are interested in the design, testing and control of concrete mixtures. The five cities at which the courses will be given are Milwaukee, Janesville, Eau Claire, La Crosse and Wausau.

General Jadwin Honored by Terminal Engineers

Honorary membership in the Society of Terminal Engineers was conferred upon Major General Edgar Jadwin, Chief of Engineers, U. S. Army, at a joint meeting of that society with the New York Post of the Society of American Military Engineers held in New York on Jan. 8. Following the presentation of the certificate of honorary membership General Jadwin addressed the meeting, taking as his subject "Army Engineers and Terminal Development." Other speakers included Wm. Barclay Parsons, Rear Admiral F. R. Harris and Francis Lee Stuart.

The newly elected presidents of the two organizations, Victor Gelineau, chief engineer of the New Jersey Board of Commerce and Navigation, of the Terminal Engineers, and Billings Wilson, deputy manager of the Port of New York Authority, of the Military Engineers, were inducted into office during the business meeting which preceded the presentation of General Jadwin.

Santa Fe Permitted to Build 35-Mile Cutoff in Texas

Permission has been granted by the Interstate Commerce Commission to the Santa Fe Railroad for the construction of a 35-mile cutoff from the Cane Belt Railroad near Lane City, Tex., to Thompsons, Tex., on the Santa Fe's main line 51 miles north of Galveston. Construction of this cutoff must be completed before July 1, 1931. The new line will avoid the present long haul from Cane Belt points to Galveston by way of Sealy, and will tap rich sulphur deposits in and around Boling Dome.

At the same time the commission denied the application of the Gulf Coast Lines for authority to construct a 25-mile line from Brazoria to the northwest, and a 9-mile line from Algoa to Dickinson, Tex.

New York Power Companies Petition to Consolidate

Petition has been made to the New York Public Service Commission by the Buffalo, Niagara & Eastern Power Corporation, the Lockport & Newfane Power & Water Supply Company, the Buffalo General Electric Company, the Niagara Electric Service Corporation, the Niagara Falls Power Company, the Niagara, Lockport & Ontario Power Company and the Tonawanda Power Company, serving many municipalities in western New York with electricity, for permission to consolidate into the Niagara Power Corporation.

The petition states that "the directors of the petitioner companies believe that the consolidation will make for efficiency of service throughout the extensive territory served by the six operating companies. A consolidation will facilitate the operation of the several electric plants as an entirety and will assist financing improvements."

Aswan Dam Raising

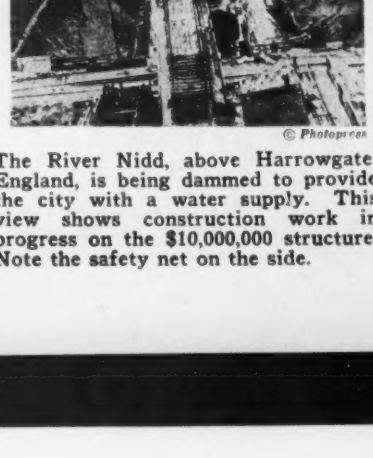
In a news report concerning the proposed raising of the Aswan dam in Egypt, published on p. 37 of the Jan. 3 issue of *Engineering News-Record*, Hugh L. Cooper was quoted as stating that the Egyptian government will adopt the report of the international board of engineers and put the work under contract in the near future. This statement was in error. Colonel Cooper simply stated that *it is expected* that the Egyptian government will adopt the report.

New York Port Authority Asks Control of Vehicular Tunnels

Jurisdiction over present and future river crossings between New York and New Jersey is to be asked of the state legislatures by the Port of New York Authority in its annual report to the two state governments, according to a preliminary announcement given out on Jan. 6. The advance announcement has been made in order to clarify the Port Authority's position in regard to future bridges or vehicular tunnels across the Hudson River, in view of the recent recommendation of the bridge and tunnel commissions of the two states that an additional tunnel be built under the Hudson River in the immediate future, and also the possibility of bills being introduced into the legislature authorizing such tunnels to be built by others than the Port Authority.

The Port Authority points out that it has successfully financed and built the two great highway bridges over Arthur Kill at less than the estimated cost and in less than the estimated construction period, that it is now ahead of its schedule on the Hudson River bridge and the arch over Kill van Kull, and that it is in a position to finance the construction of another tunnel without additional cost to either state.

BUILDING LARGE ENGLISH WATER-SUPPLY DAM



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The River Nidd, above Harrowgate, England, is being dammed to provide the city with a water supply. This view shows construction work in progress on the $10,000,000 structure Note the safety net on the side.

States to Take Over Toll Bridges Between Oklahoma and Texas

Acquisition of several toll bridges spanning the Red River between Texas and Oklahoma by the two states, either by purchase or other means, was agreed upon at a recent meeting of representatives of the Attorney Generals and Highway Departments of each state at Dallas. Immediate steps to bring the two states together on a purchase deal will be sought.

The Loy bill, passed by the last Texas legislature, gives the state a right to negotiate for the purchase of toll bridges. Oklahoma representatives said that a similar bill will be introduced in the Oklahoma legislature.

Brief News

THE WALNUT STREET BRIDGE over the Susquehanna River at Harrisburg, Pa., has recently been purchased by the Empire Toll Bridge Company of New York City. The bridge, which carries vehicular and street railway traffic, was built in 1890 of wrought iron and has a total length of 2,811 ft.

PLANS ARE PROGRESSING at Vancouver, B. C., for the erection of a highway bridge across the False Creek inlet, to cost approximately $3,000,000. This structure, which will be known as the Burrard St. bridge, is one of the major projects in Vancouver's plans ultimately to take care of a million population. It will provide direct access to Point Grey, a municipality of Greater Vancouver.

AN APPLICATION to construct a dam on Salt River, Gila County, Arizona, and for a power house generating 6,000 hp., together with power transmission lines leading to neighboring copper mines, was filed with the Federal Power Commission Jan. 4 by James Giraud, of Phoenix, Ariz. The dam would be 150 ft. high.

THE NEW YORK STATE WATER Power and Control Commission has granted power to the village of Massena, N. Y., to purchase the plant of the water-distributing system of the St. Lawrence Water Company for $185,623. Bonds for its purchase are to be sold by the village board.

THE NATIONAL PARK SERVICE will connect the General Grant and Sequoia parks in California by a road passing through 14 miles of forests, beginning and ending at Fresno. At present there are no good roads connecting the two parks.

A SHORT COURSE for sewage plant operators will be conducted at Rutgers University, New Brunswick, N. J., Jan. 14-26, 1929. The New Jersey State Department of Health and the New Jersey Sewage Works Association are co-operating with the university authorities.

Back Issues of Bound Volumes

A request has been made to the editorial office of *Engineering News-Record* as to where a complete set of bound volume of *Engineering News* and *Engineering News-Record* from 1874 to date can be obtained. Will any one wishing to dispose of such a set please advise the editor?

A partial set of unbound volumes of *Engineering News* for the years 1897 and 1898, also 1900 to 1916, is available for any one wishing to complete a set of volumes of *Engineering News*.

Licensing of Engineers Proposed by California Association

A bill will be introduced by the California Engineers Registration Association to the state legislature in January that would require the licensing of engineers in California. Engineers of the state, through the association, have been at work on the legislation for nearly a year, and expect that qualifications will be demanded that will afford a check on untrained and incompetent engineers.

Officers of the association are: Donald M. Baker, president; Frank H. Olmsted, C. L. Kaupke, Walter R. Fleming, E. Earl Glass, Philip Schuyler and E. N. Bryan, vice-presidents; Pecos H. Calahan, secretary and treasurer.

1928 New York Rapid-Transit Contracts Total $80,000,000

Contracts totaling $80,000,000 were awarded or bid for during the past year on rapid-transit construction work in the city of New York, according to the Board of Transportation. Of this amount $77,000,000 was for eighteen sections of the city's new subway system, principally in Brooklyn, Bronx and Queens. This exceeds the 1927 contract awards by $9,000,000.

The program of the board during the coming year calls for construction contracts for the entire length of the Queens line to Hillside Ave., Jamaica, and also to extend the line of the Astoria existing rapid-transit system. In Brooklyn, only two short elevated sections of the Jay-Smith St.-Culver line remain to be contracted for to have the city's new system under contract from upper Bronx to Coney Island.

On Feb. 5 bids will be received for construction of part of the Fulton St. subway in Brooklyn from St. Felix St. to Washington Ave. and along Lafayette Ave. from Fulton St. to South Oxford St., and also for the second section of the Fulton St. line from Washington Ave. to Nostrand Ave. Later in February bids will be received for the construction of part of the Brooklyn crosstown line along Schermerhorn St. and Lafayette Ave. from Bond St. to St. Felix St.

Since the Board of Transportation awarded the first subway contract for the city's new system early in 1925, the total amount of contracts to the end of the year 1928 have amounted to $259,853,825.

Huge Office Building to Replace Waldorf Hotel in N. Y. City

The sale of the Waldorf-Astoria, a famous hotel in New York City, together with the plot of ground upon which it stands and where it is planned to construct a 50-story office building with 2,250,000 sq.ft. of floor space, has

50-STORY OFFICE STRUCTURE WITH OVER 2,000,000 SQ.FT. FOR NEW YORK CITY

been characterized as the largest and most important real estate transaction of the past year in New York City. Estimates place the actual sale price at approximately $20,000,000. The property includes a 200-ft. frontage on Fifth Ave. between 33d and 34th Sts. and 425 ft. along the two side streets, including the hotel (originally two hotels, the Waldorf and the Astoria), a private driveway at the rear of the hotel between 33d and 34th Sts. known as Astor Court and the Astor Court office building, an eight-story structure to the west of Astor Court. The purchaser is the Bethlehem Engineering Company, of which Floyd de L. Brown is president.

The new building which has been designed for the site by Shreve & Lamb, architects, is shown in the accompanying illustration. It will occupy the entire site, 200x425 ft., the bulk of the structure rising in two setbacks up to the tower, which begins at the thirtieth floor. This tower will rise twenty stories to the penthouse, making a total of 50 stories, and a total height of the building from the sidewalk to the top of approximately 650 ft. The ground floor will include shops on all street fronts, with two arcades, one running from the center of the Fifth Ave. facade, the other at the center of the side street facades, intersecting to form a rotunda at the center of the building. These arcades will give access to the various series of passenger elevators, of which there will be five groups of eight cars each. The second floor will be about 23 ft. high, suitable for bank occupancy, and above this will be several floors of extra height for such special use as rug display rooms. The tower will contain almost 21,000 sq.ft. on each floor and will be served by sixteen high-speed automatic elevators. The total area of all floors in the building, including three basements, will be something over 2,250,000 sq.ft. The installation of ramps to the basement to accomplish interior truck loading and to reach a basement automobile terminal is being considered. Wrecking of the hotel is planned to commence in June.

Model of 1,675-Ft. Arch Bridge to Be Shown to Civil Engineers

The method in which a 10-ft. bronze model of the 1,675-ft. Kill van Kull bridge is used to check design stresses is to be demonstrated during the convention of the American Society of Civil Engineers in New York next week. The model will be on display at the Museum of the Peaceful Arts, on 40th St. back of the Engineering Societies Building, from 12 to 2 and from 5 to 8 p.m., Thursday, Jan. 17.

The model was built by engineers of the Port of New York Authority under the direction of O. H. Ammann, chief engineer of bridges, for the purpose of checking the stress calculations in the Kill van Kull bridge, now under construction at New York.

First Contract Awarded on Navy Munitions Depot in Nevada

The first contract on the Navy Department's proposed $3,500,000 munitions depot at Hawthorne, Nev., has been let to Schuler & McDonald, Inc., of Oakland, Calif. The contract covers the construction of a railroad spur from the Southern Pacific to the magazine area and industrial center of the new depot, and amounts to $120,700. Work on the plans and specifications for the other units of the development is progressing rapidly and it is expected that contracts for the remainder of the work will be let early in the current year.

Murray Appointed Member of Port of New York Authority

John F. Murray, of Brooklyn, has been appointed a member of the Port of New York Authority by Governor Roosevelt, to succeed Herbert K. Twitchell, of Brooklyn, deceased. Mr. Murray was born in Albany, N. Y., and was educated at Brooklyn Preparatory School and Stevens Institute of Technology. For mnay years he was vice-president and general manager of the Metropolitan Service Corporation, Brooklyn, and in 1923 became executive vice-president of Thomas E. Murray, Inc., New York City, consulting engineers, which position he now holds. He is also vice-president of the Metropolitan Engineering Company, of Brooklyn, the Murray Radiator Company and the Murray Conduit Systems.

Examiner Recommends Moffat Road Build Dotsero Cutoff

The Denver & Salt Lake Western Railroad should be permitted to build the 41-mile cutoff from Orestod, on its line, to Dotsero, on the Denver & Rio Grande Western Railroad in Eagle County, Colorado, according to recommendations made to the Interstate Commerce Commission by one of the commission's examiners. The recommendations also state that permission given to the Moffat road for the construction of the cutoff should be upon the condition that the Denver & Rio Grande be permitted to operate on fair and reasonable terms over the cutoff and over the Moffat road east of Orestod. It is also recommended that the commission order the D.&R.G.W. to submit attested copies of a formal contract or agreement to be made with the Moffat road, setting forth the terms and conditions which it, the Rio Grande, is willing to accept as governing its operation over the proposed cutoff and the Moffat line.

War Department Holds Bridge Hearing at San Francisco

Plans for an 18,000-ft. toll bridge across an arm of San Francisco Bay from Richmond, Contra Costa County, to the Marin County shore were placed on Jan. 3 before Major E. H. Ropes, Engineer Corps, U.S.A., district engineer at San Francisco. The project is sponsored by Oscar H. Klatt, president of the American Toll Bridge Company, which owns the Carquinez bridge, located 15 miles above. Opposition to the application, principally by shipping interests, united in demanding various major changes in plans, notably two 1,500-ft. spans over the main channel where the plans showed one 1,400-ft. span and a 200-ft. lift span where the plans indicated fixed spans 155 ft. above water level. The matter has been referred to the War Department.

Issue Proposed Standards for Drafting-Room Practice

Recommended practice for line work on engineering drawings has been issued in tentative code form through the American Society of Mechanical Engineers, New York City. The specifications have been prepared by a committee on the standardization of drawings and drafting-room practice, consisting of 53 members representing 32 national organizations, and are sponsored by the American Engineering Standards Committee. The specifications take up such subjects as the character and width of lines, standard cross-sections for various metals, riveting conventions and other common features of drafting.

Criticisms and comments on the new standards are invited, and should be sent to C. B. LePage, assistant secretary, American Society of Mechanical Engineers, 29 West 39th St., New York.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Year's River Work Reviewed—Floodway Landowners Hesitant—Public Contract Act Revived

WORK on the Mississippi under way for the current year was reviewed by Major-Gen. Edgar Jadwin and Col. T. M. Robins, of the Corps of Engineers, before the House subcommittee on appropriations. In accordance with the plan adopted in the flood-control act of 1928, it is stated that $24,000,000 will have been spent or obligated by the close of the fiscal year. An appropriation of $30,000,000 is asked for next year. Prior to the act, the annual expenditure for Mississippi flood control was about $10,000,000.

Of this year's funds, $12,000,000 will go for bank revetment, $10,000,000 for levee work and $1,000,000 for maintenance and dredging, Colonel Robins said. In addition, allotments of $400,000 have been made from the emergency fund of $1,000,000 appropriated last year for rescue work and for maintenance and repair on tributaries. Only $50,500 has been spent so far on miscellaneous small items previously authorized and not connected with the plan, although provision was made for the use of up to $10,000,000 for this purpose.

Land Prices for Floodways

Thirty-eight per cent of the owners of the land included within the guide levees of the proposed floodway through the Tensas and Atchafalaya basins of Louisiana have responded to the request of the Corps of Engineers for a price for the outright purchase of their lands and for a price for flowage rights only. The exact average of the prices asked has not been calculated as yet, but it is known to be many times the assessed value of the lands. Under existing law the State of Louisiana may condemn lands for flood-control purposes at the assessed value.

In gathering the data the Engineer officers explain that their interpretation of the act is that it does not provide for payment where "no additional destructive flood waters" are to be diverted from the Mississippi River. It was pointed out, however, that Congress might alter the law in that respect and that the data were desired for the information of Congress.

Representative Wilson, of Louisiana, member of the flood-control committee, declares that the returns present an unfair picture of the situation. There was no negotiation or effort to induce the landowners to accept a lower price, he says. Sixty-two per cent of the landowners declined to answer the questionnaire. This, he explains, is due to the fact that the people are not fully informed as to the exact plans in contemplation.

A majority of the members of the flood-control committee believe the law as it reads provides definitely for compensation for damages caused by the proposed diversions. A subcommittee is considering possible changes in the law to make that point clear. When this proposed amendment has been perfected it is planned to hold hearings at which the Chief of Engineers will be called upon to explain how he justifies his position that no payments for damages are to be made.

Government Contracts

The Cramton public contract act, which was submitted to the interdepartmental board of contracts at the last session of Congress for further consideration, has been reintroduced in the House with the unanimous indorsement of the departments as well as with the approval of the administration. It was revealed by statements filed with the bill, however, that the comptroller general is still not in accord with some of the provisions.

At the suggestion of the departments, provision is made in the new bill for remission of damage payments imposed on contractors for delay in cases where the department head may decide that the government suffered no loss because of such delay. This section dealing with liquidated damages was written in the original bill, but was omitted during the hearings last session due to the opposition of the comptroller general. The insistence of department heads that they be vested with authority to remit damage payments is expected to precipitate another clash with the general accounting office.

Mr. Cramton told the House that the section dealing with the awarding of contracts to other than the lowest bidder has been modified so that it probably will satisfy the comptroller general.

Boulder Dam Discussion

Opinion as to the prospects for carrying forward the Boulder dam project varies widely. Opponents of the development are outspoken in their belief that Arizona will not ratify and will carry the case to the courts. Representative Swing, of California, the author of the House bill, says this is as good a time as any for litigation, if it must come. One beneficial effect of a decision by the Supreme Court, he points out, is that the constitutional questions involved will have been settled forever.

On the other hand, proponents of the project point out that Arizona, in the act as approved, has secured the maximum that it can hope to get. Irrigation interests in the Imperial Valley are understood to be in doubt as to whether or not the reduced amount of water allowed California will justify the additional development they had planned.

In view of the passage of the Boulder dam legislation, Dr. Elwood Mead, as chairman of the American Section of the International Water Commission, has asked the Mexican members if an early meeting could be held.

Personal Notes

JOHN F. SULLIVAN, formerly consulting engineer to the Borough President of Manhattan, has been appointed consulting engineer to the Board of Estimate of the City of New York to act as engineering adviser to Mayor Walker. Mr. Sullivan is expected to assist materially in plans for the contemplated bridges and tunnels and the West Side improvements.

JACOB S. LANGTHORNE has been appointed consulting engineer to the Borough President of Manhattan to relieve John F. Sullivan. Mr. Langthorne has had long experience in municipal engineering for New York, particularly in the construction of the Catskill water-supply system. At the time of his appointment he was vice-president of the George A. Shedden Company, New York, building contractors.

CYRUS C. BABB, consulting hydraulic engineer, of Granite Falls, N. C., has accepted a temporary assignment to the Charleston, S. C., district office of the U. S. Corps of Engineers. He will be engaged on an investigation and survey report of the Catawba-Santee River basin and of the Yadkin-Peedee River basin, covering flood control, storage, undeveloped power, drainage and navigation. The work is under the direction of Major N. Y. DuHamel, district engineer, and J. A. Grant, deputy district engineer.

MAX L. CUNNINGHAM, of Guthrie, Okla., has been appointed engineer of maintenance in charge of plans and specifications with the Louisiana Highway Commission.

NELSON N. FULLER, sanitation engineer of Jacksonville, Fla., has been appointed sanitation engineer of Cattaraugus County, New York, effective Feb. 1. Mr. Fuller went to Jacksonville in 1926 from Montclair, N. J., where he was assistant health officer.

GEORGE SHEARER, head of the Washington state highway in the Spokane district, has been placed in charge of the Seattle district. He will be succeeded in Spokane by L. A. MCLEOD. JOHN DUFF, Chelan County engineer, will join the state highway staff in charge of the Wenatchee district.

J. ED ALLSOPP, of Little Rock, Ark., who has recently been employed by the Florida Road Department as project engineer, has been appointed sales representative and engineer for the Arkansas Lime Products Comany, with headquarters in Little Rock.

HENRY C. ULEN, FRED DONALDSON and WILLIAM T. BRENTON have filed articles of incorporation at Indianapolis for the formation of a general contracting company to be known as Donaldson & Company, of Lebanon, Ind. Mr. Ulen is head of the New York firm of Ulen & Company.

ALLEN HAZEN, Chester M. Everett, Malcolm Pirnie and Leroy N. Babbitt, New York, have changed the name of their partnership from that of Hazen & Whipple to that of Hazen, Everett & Pirnie. Mr. Whipple, who became a member of the firm in 1904, died in 1924. Mr. Everett joined the organization in 1907 and has been a member of the firm since 1915. Mr. Pirnie has been in the business since 1911 and a partner since 1917, and Mr. Babbitt, who has been with the organization for 33 years, has been a partner since 1904.

CHARLES S. KEATING, formerly deputy engineer of the engineering department of the city of Syracuse, N. Y., has been appointed consulting engineer to the department. In a reorganization of the department WILLIAM F. CAVANAUGH becomes assistant engineer; POTTER W. KELLY assumes charge of construction; ELSON P. STEWART will be engineer in charge of the water division, and GEORGE T. BOLTON will be senior engineer in the water division.

ROBERTSON N. WAID, of Columbus, Ohio, has been appointed director of highways for the State of Ohio by Gov. Myers R. Cooper, succeeding HARRY J. KIRK, who has held the position since last June.

Obituary

FRANK DOUGLAS NAUMAN, engineer of maintenance-of-way of the Oregon Short Line Railroad, died Christmas day at Pocatello, Idaho.

SOLOMON SHEARER, pioneer building contractor of Auburn, Ind., died at his home there at the age of 80.

WALTER E. ANGIER, bridge engineer of experience on many large structures and a member of the firm of Modjeski & Angier, consulting engineers, Chicago, died at his home in Wheaton, Ill., on Dec. 29. Mr. Angier was born at Fitzwilliam, N. H., in 1863. He was graduated in 1885 from the New Hampshire College of Agricultural and Mechanical Arts and in 1887 from the Thayer School of Civil Engineering at Dartmouth College. In 1887 he was engaged on the construction of the Mississippi River bridge at Fort Madison, Iowa, for the Chicago extension of the Atchison, Topeka & Santa Fe Railway, under Octave Chanute, chief engineer. For two years he was U. S. assistant engineer on the Galveston harbor and other work in Texas. During 1889-92 he was assistant engineer on the Memphis bridge over the Mississippi, under George S. Morison, chief engineer, and Alfred Noble, resident engineer. In 1893 he went to the Illinois Central Railroad as assistant engineer in the bridge department and remained in that position for several years. He then became associated with Ralph Modjeski and later a partner with him. For the past two or three years Mr. Angier had been in ill health.

WILLIAM P. ROBINSON, chairman of the Moffat Tunnel Commission, died Jan. 1 at Denver, Colo., at the age of 67.

JOHN F. TORPEY, commissioner of public works in Yonkers, N. Y., and for many years a civil engineer with the city of New York, died Dec. 29, 1928, at his home in Yonkers.

JOB TUTHILL, assistant chief engineer of the Pere Marquette Railway, died Dec. 28 at his home in Detroit. After graduating from the University of Michigan in 1883, Mr. Tuthill went into railroad construction in the West, being a member of the party making the first survey of the cog road up Pike's Peak. He was with the Pere Marquette from 1900 to 1909 and from 1917 to the time of his death. For a time prior to 1917 he was assistant to Dean Mortimer Cooley, of the University of Michigan, and was also engaged in valuation work on the New York Central Lines. He was 73 years of age.

EDWARD PALMER YORK, of Princeton, N. J., a member of York & Sawyer, New York architects, died in New York City Dec. 30. In 30 years of active practice he designed many prominent buildings throughout the East and was working on the proposed new building for the Department of Labor at Washington.

OLIVER C. BREED, 79, prominent civil engineer of Fulton, N. Y., and the first city engineer of Fulton, died at his home there on Dec. 29. For several years he was a member of the Oswego River watershed commission and engineer for the Fulton hydraulic race commission.

Engineering Societies

CALENDAR

Annual Meetings

AMERICAN ROAD BUILDERS' ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 14-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; annual meeting, New York, N. J., Jan. 16-18.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; annual convention, Detroit, Mich., Feb. 12-14.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; annual convention, Chicago, Ill., Feb. 18-22.

* * *

THE AMERICAN WATER WORKS ASSOCIATION will hold sectional meetings early this year as follows: Kentucky-Tennessee section, Chattanooga, Tenn., Jan. 24-26, secretary, F. C. Dugan, chief engineer, Kentucky State Board of Health, Frankfort, Ky.; Indiana section, Indianapolis, Feb. 27-28, secretary, C. K. Culvert, 1902 North New Jersey St., Indianapolis; Montana section, Great Falls, April 4-6, secretary, H. B. Foote, division of water and sewage, State Board of Health, Helena; Rocky Mountain section, Denver, Feb. 14-15, secretary, D. E. Kepner, division of sanitary engineering, State Board of Health, Denver.

Construction Equipment and Materials

Cincinnati Company to Build Industrial Locomotives

After 30 years' experience in building freight and passenger rolling equipment for city and interurban electric railway service, the Cincinnati Car Company, Winton Place, Cincinnati, Ohio, is entering the industrial locomotive field with a complete line of units in gasoline, gasoline-electric, diesel, electric trolley and storage battery types. These locomotives will be furnished in a variety of sizes, from 2- and 3-ton units up to 50-ton units or larger. H. R. Sykes, who is well known to many of the locomotive-using public, will be in charge of sales and service of the locomotive division of the company.

Cement Company Plans Barge Line Between Plants

Announcement has been made by the Marquette Cement Manufacturing Company of the completion of plans for the inauguration of a barge line between Cape Girardeau, Mo., and Memphis, Tenn., to be utilized for the transportation of bulk portland cement from its plant at Cape Girardeau to storage silos in Memphis, where it will be packed in bags for reshipment for local consumption. A movement of 250,000 bbl., or 1,000,000 sacks, in a ten-month period is contemplated.

The necessary docks and trackage have already been built at Cape Girardeau. The packing plant at Memphis will consist of a series of reinforced-concrete silos 60 ft. high and several units of Bates cement packers, together with elevators, slides and belt conveyors. The Memphis terminal will be located on the Wolf River Canal, in which dredging operations are now in progress. The canal will have a maintained bottom width of 200 ft. at the mouth and as far north as Auction St. and a maintained depth of 9 ft. of water at all times.

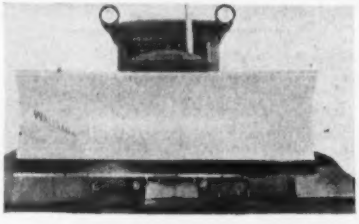
An all-steel twin-screw diesel-propelled towboat has been designed capable of developing 720 hp. The design was made by T. R. Tarn, naval architect, 18 Fancourt St., Pittsburgh, Pa. The barges, also designed by Mr. Tarn, will be 175x35x8 ft. and the exterior appearance will be that of a standard river barge with a low deck housing. However, within the deck housing and extending down into the hull are located three longitudinal hopper-bottom bins. Beneath each bin and running the length of the barge is a 12-in. screw conveyor, and between the screw conveyors and the bins will be located the gates or slides for controlling the flow of cement. The three longitudinal conveyors will discharge into a cross-conveyor, which in turn will discharge at one point into a Fuller Kenyon pump, which will transport the cement through a 5-in. pipe line out of the barge through a flexible hose connection between barge and land and through a similar 5-in. pipe line into the storage silos at the terminal. All seams and joints of the barge hoppers will be welded.

Company officials expect to let contracts for the construction of the towboat, barges and terminal about Feb. 1.

New Developments

Mechanical Bulldozer for Heavy Tractor Application

A new mechanically operated bulldozer for attachment to the Caterpillar "Sixty" tractor has been developed by the Wausau Iron Works, Wausau, Wis.



The bulldozer is raised and lowered by the operator by means of a hoist operated direct from the power plant of the tractor.

Convertible Excavators in 5- to 15-Ton Sizes

Two models of power excavators have been developed by the Browning Crane Company, Cleveland, Ohio. The Type E convertible shovel and crane of 5- to 7½-ton capacity is available either as a crawler-mounted or truck-mounted unit. The latter model is shown in one of the accompanying illustrations. The Type F machine has a capacity of 15 tons and is shown in one of the accompanying illustrations fitted with a long and special type boom. In the

Type E machine a one-piece steel casting is used for the lower base on the crawler mounting, while a structural steel sub-base is built to fit the desired truck chassis when the machine is truck mounted. In both machines the rotating base is a one-piece steel casting which serves as a rigid mounting for all machinery. Both the hoist and hold drums are power driven and special patented differential brakes are used on them. These brakes are set at the start of the hoisting operation and are automatically applied when the power is released. This eliminates one operation, since it is necessary to use only the clutch lever instead of both the clutch and brake levers. Another important feature is that the rotating is done by foot pedal rather than by hand lever. The Type E has a capacity of ½ cu.yd. and is fitted with either a 50-hp. four-cylinder Climax engine or a 55-hp. four-cylinder Waukesha engine.

In the Type F machine unusually heavy one-piece steel castings are used for both the lower and the rotating bases. It is regularly equipped with an 85-hp. Twin City gasoline engine, electric starter and steering mechanism and many other refinements.

New Heavy-Duty ¾-Yd. Power Shovel

A crawler shovel-crane-dragline machine, known as Type K-25, has been added to the line of power shovels manufactured by the Link-Belt Company, Chicago. It is a heavy-duty, ¾-yd. machine, powered either with gasoline engine, diesel engine or electric motor drive as desired. As a dragline or crane it will handle a ¾-cu.yd. bucket on a 40-ft. boom. Typical features of the machine are: One-piece annealed cast-steel lower frame and rotating base; self-cleaning chrome steel crawler treads; large bronze-bushed crawler rollers; totally inclosed lower-frame travel gears, running in oil; full steel house inclosing operator and the machinery; unusual accessibility and comfort for the operator.

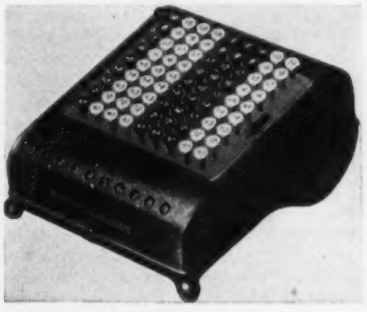
Air Cylinder for New Scarifier Under Deck of Roller

A new scarifier has been designed for the 10-ton motor roller manufactured by the Huber Manufacturing Company, Marion, Ohio. An important feature of this scarifier is the fact that the operating cylinder is placed underneath the deck of the roller where it is out of the way and where the pressure can be applied to the scarifier bars through bell arms and levers, thus multiplying the cylinder pressure as it is

transmitted to the tooth bar. The tooth bar is a solid steel casting with gage wheels at the ends to regulate and control the depth of the cut. The teeth are detachable and reversible and are held in place by a spring plunger, it being necessary only to compress the spring to release the tooth. The bar is held close to the rear rolls, which is acclaimed to be a decided advantage when rough surfaces are being scarified.

Calculating Machine Operated by Electric Power

Increased speed in calculation and reduced physical effort on the part of the operator is secured by the use of an electrically operated calculating machine now being introduced by the Burroughs Adding Machine Company, Detroit, Mich. A small motor, operating on either alternating or direct current, is inclosed within the case of the machine and runs only when a key is depressed.



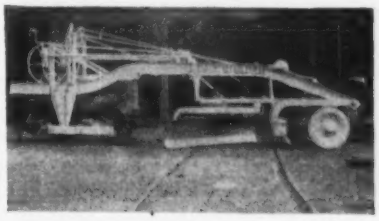
Special attention has been paid in the design to the reduction of errors caused by incomplete strokes of the keys. It is claimed that the extremely light touch used in the new machine makes it impossible to misoperate a key.

Gasoline Power Shovel of ½-Yd. Capacity Develops 48 Hp.

The latest addition to the line of power shovels manufactured by the Bucyrus-Erie Company, South Milwaukee, Wis., is a ½-yd. gasoline machine designated as its Model 1020. This machine is similar to the company's ¾-yd. Model 1030, which has been in the field during the past year. The new ½-yd. machine has been developed to meet the need for a smaller gasoline power shovel with more power than is ordinarily found on excavators of its rated size; the Model 1020 utilizes a 4½x6¼ Waukesha engine which develops 48 hp. The machine is convertible to clamshell crane, dragline, power shovel or drag shovel.

Grader Attachment for Tractor

A new addition to the series of graders produced by the Rome Manufacturing Company, Rome, N. Y., is the Model K-20, designed for attachment to the K-20 Cletrac tractor manufactured by the Cleveland Tractor Company. This machine consists of a main frame of 25½-lb. I-beams to which is attached a scarifier and a scraper blade. The latter is furnished in 8-, 10- or 12-in. widths.



Business Notes

HARNISCHFEGER CORPORATION, Milwaukee, Wis., has appointed the Ed. P. Phillips Machinery Company of Richmond, Va., as district agent.

LEIPZIG TRADE FAIR will be held March 3-13, 1929. Its American offices are located at 11 West 42d St., New York City.

AUSTIN-WESTERN ROAD MACHINERY COMPANY, Chicago, announces the appointment of H. L. Teal as branch manager for the State of Ohio, with offices at 335 South High St., Columbus, Ohio, succeeding William E. Wright, who has been appointed state manager of Wisconsin.

THE BUILDING PRODUCTS COMPANY, Toledo, Ohio, announces a change in its name to the HAUSMAN STEEL COMPANY. It is announced that the change was predicated upon the fact that the name "Building Products," although correctly describing the company's business, did not give it the individuality and distinctiveness that it felt necessary. The company was founded fourteen years ago and has had a rapid growth, maintaining warehouses in both Columbus and Toledo, as well as a large plant devoted entirely to the fabrication, maintenance and repair of steel forms for concrete construction.

FULLER & JOHNSON MANUFACTURING COMPANY, Madison, Wis., announces that control of the company has been purchased by the Second Ward Securities Company and the Quarles Company, of Milwaukee, both investment houses. The officers of the company remain unchanged and a policy of sales expansion will be followed. No merger of the company is involved and operations will be carried out entirely independently of the Waukesha Motor Company, as the two companies manufacture noncompeting lines. For the past two years the Fuller & Johnson company has been operating under a license from the Waukesha Motor Company for the use of the Ricardo head on its engines. Preliminary plans for the future include the development of a series of small engines for the industrial trade.

New Publications

Water Softeners — INTERNATIONAL FILTER COMPANY, Chicago, Ill., has issued an illustrated booklet discussing the advantages of upflow water softening and the chemistry, early history and development of zeolite. A number of diagrams and charts are used.

Light Steel Beams—JONES & LAUGHLIN STEEL CORPORATION, Pittsburgh, Pa., has issued a 56-p. book of information about J. & L. junior I-beams for floors, ceilings, roofs and similar light construction work. The book gives full designing data in hand-book form, together with drawings showing typical applications.

Cranes — THE CLEVELAND CRANE & ENGINEERING COMPANY, Wickliffe, Ohio, has issued Catalog C-104 devoted to the application of Cleveland cranes to power plants. Photographs are given showing actual installations. The book includes a complete description of the units which make up the Cleveland cranes.

Building Tile—CLAY PRODUCTS COMPANY, INC., Brazil, Ind., has issued a new catalog describing the textured building tiles developed by the company. This includes many detail sheets showing special constructions possible. The book is so bound that detail sheets may be removed for tracing, if desired. Inserts are used to show the tile in natural colors.

Welding Equipment—GENERAL ELECTRIC COMPANY, Schnectady, N. Y., has issued two new publications descriptive of welding equipment. One of these covers a constant-potential arc-welding set for use by several operators, which is adapted to automatic welding. The other describes a gasoline engine-driven welder for use where no local power is available.

Manufacturers and Trade Associations

CALENDAR

Annual Meetings

AMERICAN ROAD BUILDERS ASSOCIATION, Washington, D. C., annual convention, Cleveland, Ohio, Jan. 14-18.

NATIONAL CRUSHED STONE ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 21-24.

The Business Side of Construction

New York Population Needs More Even Distribution

With one of its boroughs—Manhattan—more densely populated than Shanghai, China, and with 2,500,000 persons in its five boroughs living in overcrowded "old-law" tenement houses, nearly one-half of the land in New York City is still unbuilt and largely available for dwellings, business and industry, according to a report on the population of the New York region being prepared for publication by the Regional Plan of New York and Its Environs.

Contrasting the extreme congestion which exists in some parts of the region with the very low population densities in other parts, the report declares: "What may give us hope, if we have the courage to act, is that although certain parts of Manhattan and a few spots in adjoining boroughs and towns are overcrowded, the region as a whole is not populated too densely. The present population of the whole region could be housed within the corporate limits of New York City (*297* square miles), at an average density that would be but slightly higher than the present moderate average throughout Kings County—50 persons to the acre. The area of the region is, however, 5,528 square miles (eighteen times the area of New York City).

In 1925 the average population density within the city of New York was only 30.8 per acre, which, the report says, is not an unhealthful concentration. On the unbuilt land in New York City 2,500,000 persons could be housed without raising the population density of these new areas to more than 30 persons to the acre. The report incidentally reveals that in the most congested sections of New York there is at present an average of 650 persons per acre.

The proper utilization of the available lands in the region for homes, business and industry, the report suggests, is one of the chief avenues by which present congestion and unhealthful conditions may be alleviated.

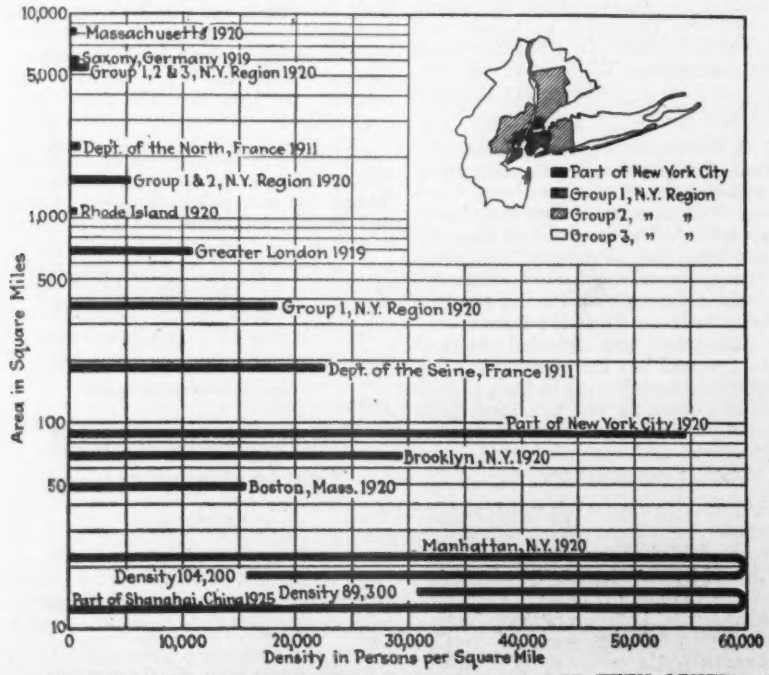
A definite trend away from the most densely populated centers toward the suburbs is, in fact, already under way, "and it is unlikely that the extreme congestion of population within small areas will ever be as great as it has been in the past." There were two assembly districts with densities of 400,000 and 387,000 persons per square mile, respectively, in 1900 in southern Manhattan, whereas the maximum fell to 261,000 per square mile in 1920. The greatest congestion in Manhattan occurred nearly twenty years ago, when there was a density of 867 persons per acre on the lower East Side. In the entire area south of Canal St. the maximum population density was reached 68 years ago, where, before the Civil War, there was an average of *270* persons per acre.

The outward trend is going on within the city limits of New York as well as outside, the report finds, with ever-increasing numbers moving away from the central districts into the outlying areas of the Bronx, Brooklyn, Queens and Richmond. Thus those parts of Manhattan and the Bronx which are in the zone between 4 and 8 miles of the City Hall of Manhattan had a smaller number of residents in 1925 than in 1920. Only beyond the 8-mile circle has there been a consistent increase.

The report finds, incidentally, that despite the great increases in population in the suburban areas, in the most distant parts of the region there has been an actual decrease.

E. N.-R. Index Numbers

	Cost		Volume	
Jan. 1, 1929	**209.40**	**December, 1928**	**244**
Dec. 1, 1928	210.16	November, 1928	251
Jan. 1, 1928	203.90	December, 1927	319
Average, 1928	206.78	Average, 1928	287
Average, 1927	206.24	Average, 1927	263
1913.....	100.00	1913.....	100



DENSITIES IN THE NEW YORK REGION COMPARED WITH OTHER URBAN REGIONS

Bright Outlook in General Business

According to the Dun weekly review of business the change from the old year to the new was accompanied by numerous definitely favorable phases in business. Annual summaries, while engaging much attention, have not obscured the current week's forward trend in various lines, and the main sentiment is distinctly cheerful. With the momentum already gained, trade gives promise of continued activity on the whole, although there is a prudent disinclination to anticipate results very far ahead. Where there is a lull now, due to normal factors, a renewed advance conceivably may occur, but most of the present expectations are confined to the first quarter of the year. The great steel industry, after experiencing an unparalleled output, is extending its expansion, the leather markets are doing better than had been indicated, and the strengthening of the situation in textiles is numbered among the other encouraging signs. More time will be required for developments to shape themselves fully, but the tendencies in the first week of the new year have confirmed the confident views recently expressed. The statistics of mercantile mortality have shown a new high level in number of failures, yet a closer analysis of the returns reveals the interesting fact that the ratio of defaults to firms and individuals in business has increased only slightly, and it is lower than on many other occasions when there were fewer failures.

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended Jan. 8, with some comparisons, total as follows:

(In Thousands of Dollars)

	Jan. 8, 1929	Jan. 1, 1929	Jan. 10, 1928
Building:			
Industrial.....	$12,898	$2,612	$4,989
Commercial.....	29,001	28,260	33,638
Streets and roads..	7,806	6,296	8,733
Other construction.	23,934	7,066	13,773
Total.....	$73,639	$44,234	$61,133
Total, all classes, Jan. 1 to Jan. 8:			
1929.....			$117,873
1928.....			124,622